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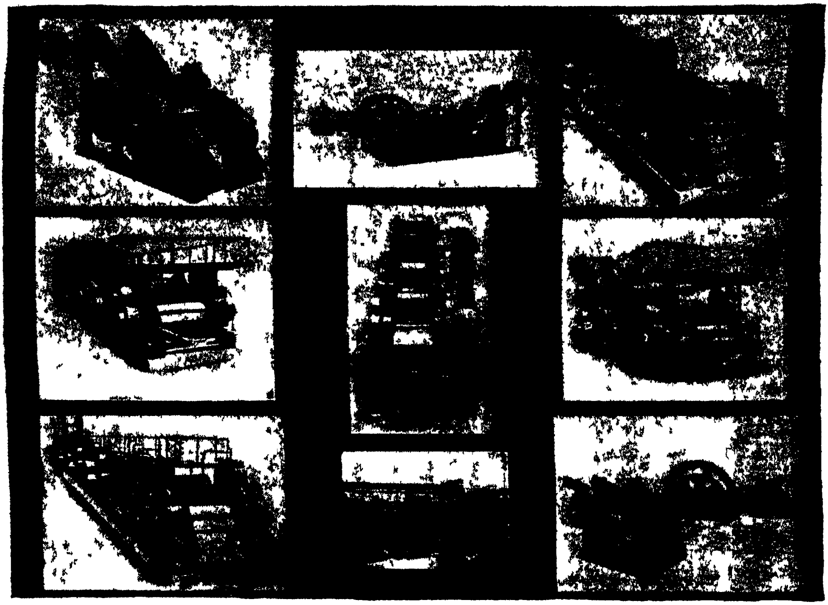

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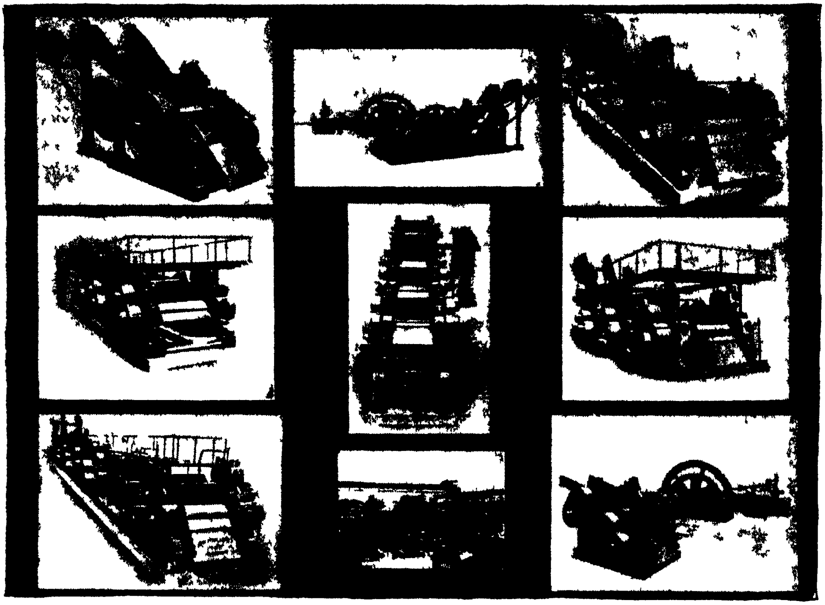

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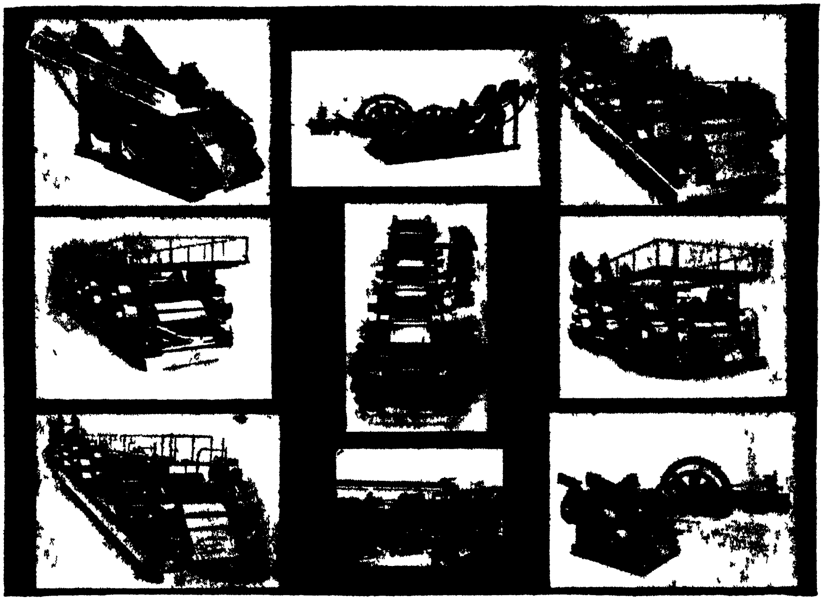

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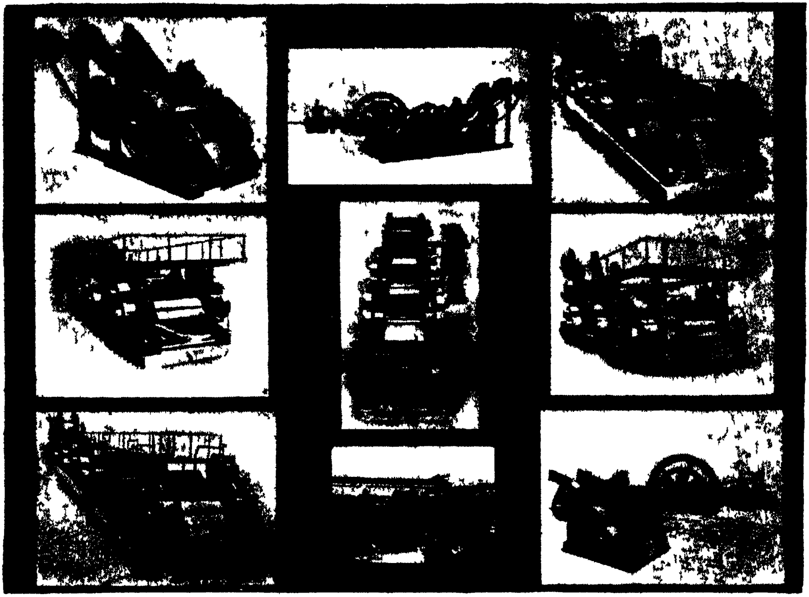

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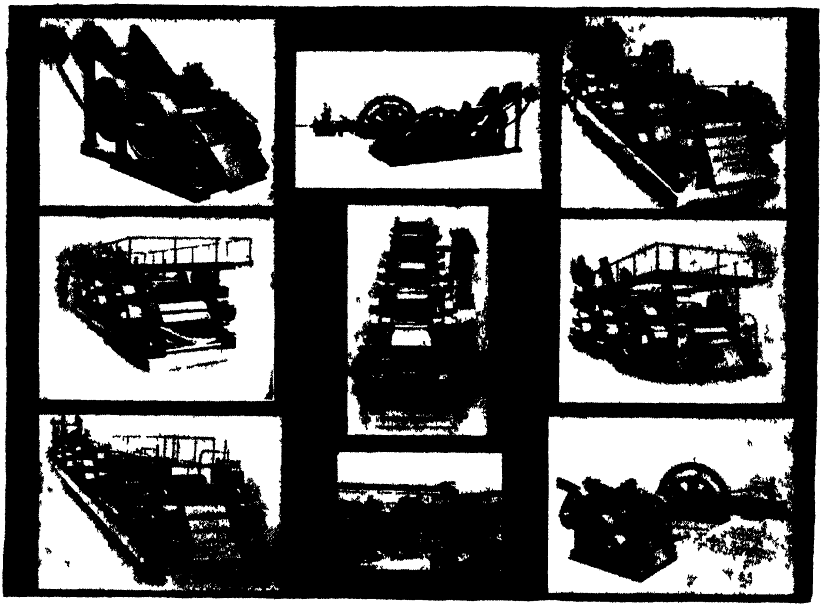

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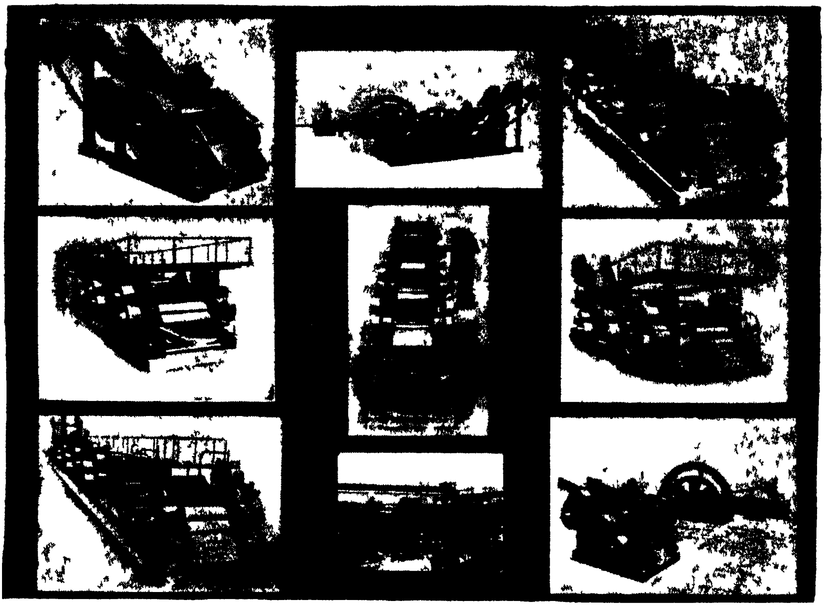

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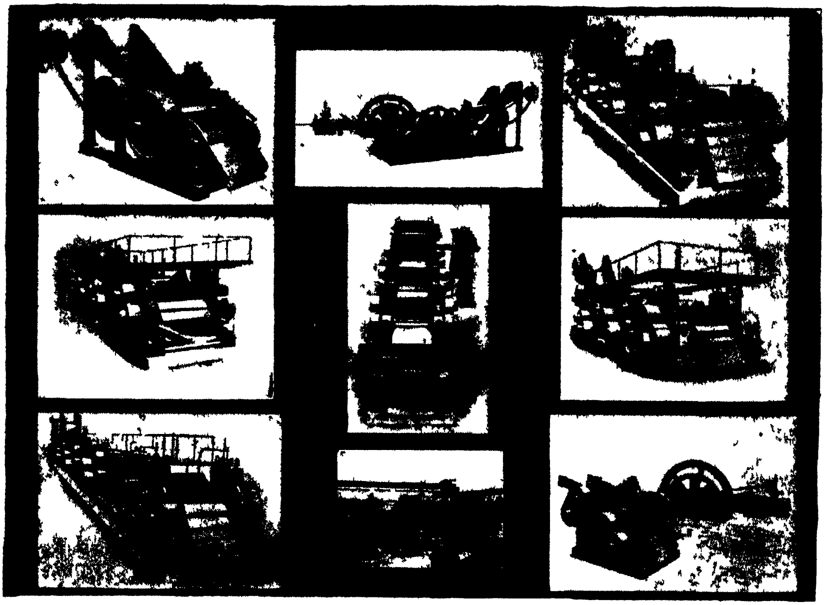

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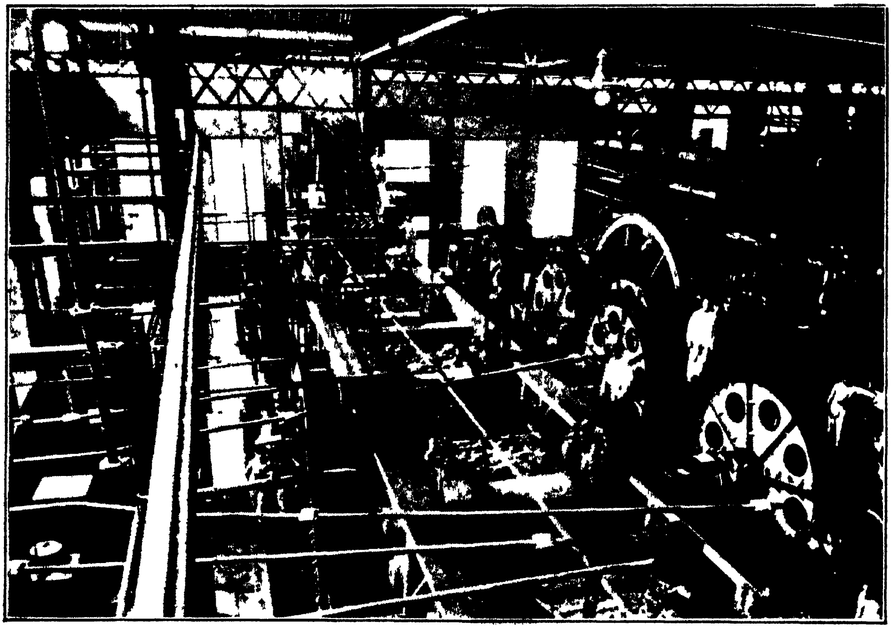

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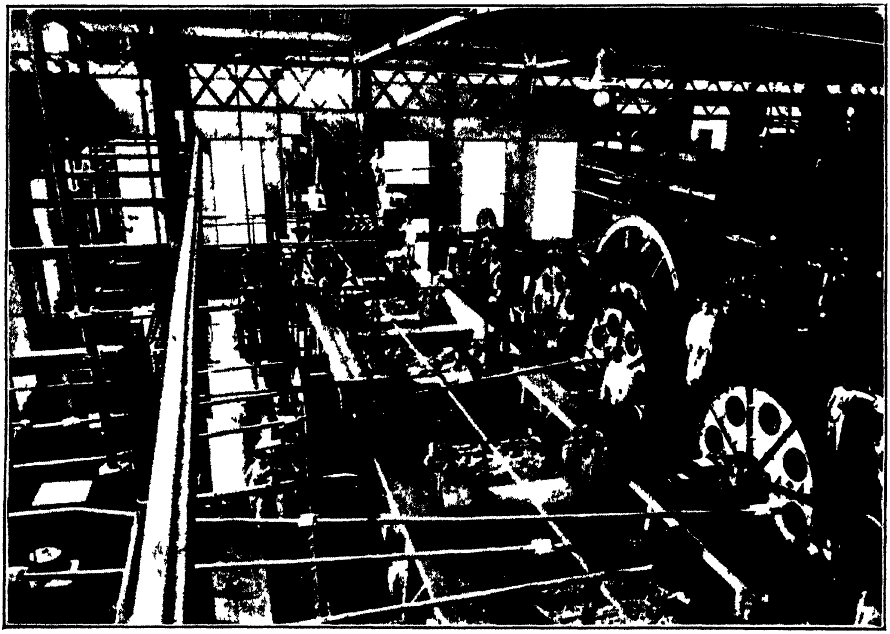

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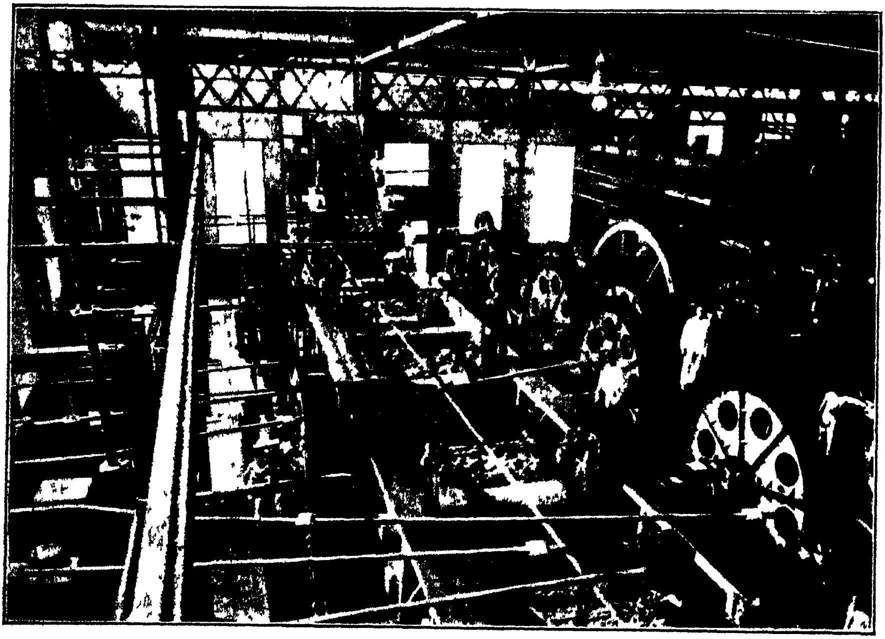

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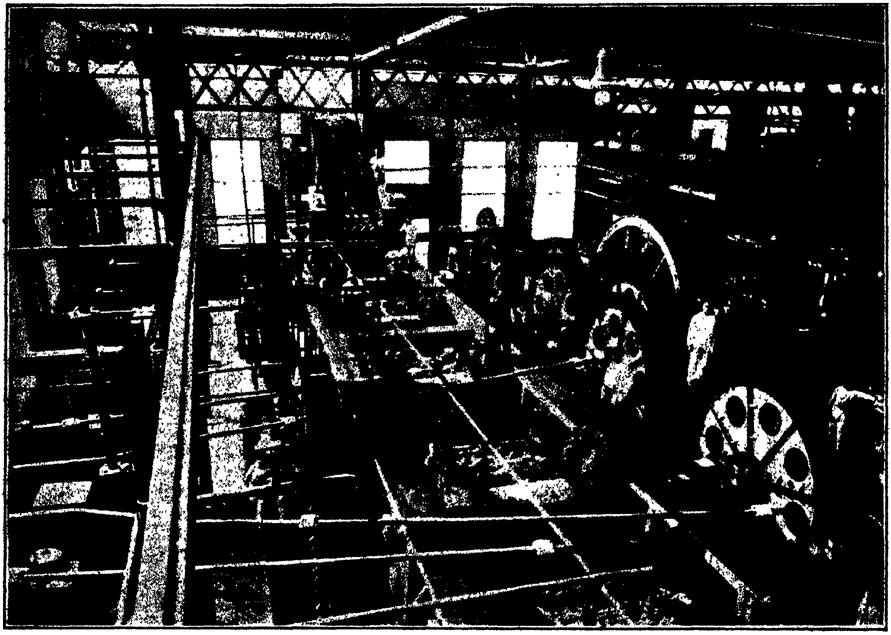

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

The Outlook for 1922.

The last 18 months has shown a steady slump in the business of sugar production and sugar marketing, and we do not know yet that the bottom of the depression has been reached or even sighted. As compared with May, 1920, when raw sugar was about 136s. per cwt., recent prices have been as low as 10s. 3d. for Cuban 96° crystals, c.i.f. United Kingdom. The present excess of production over consumption is however not due to any really excessive production in terms of pre-war output; in 1913-14 and 1914-15 the world's total of beet and cane was virtually eighteen and a half million tons, whereas the last three years it has averaged about sixteen millions only.[1] The cause lies in the lack of purchasing power on the part of the consumer the world over; the war has impoverished numerous countries, and these in their turn by ceasing to buy goods from sources less directly affected by the war (the United States in particular) have contributed to a large increase in unemployment in those countries offering the goods. The result all round is a very curtailed capacity for purchasing sugar for domestic consumption. With Cuban sugar now offering at a lower price than 88 per cent. beet fetched in 1912, it might have been supposed that the world would absorb readily enough the surplus stocks of the 1920-21 crops. But it shows no hurry to purchase them, and for the time being the world's sugar producing industry is hampered in its progress by the continuation of unremuneratively low prices, and by unsold surplusses.

A good deal seems to depend on the success or otherwise that meets the efforts of International statesmen to devise means of setting Europe on her trading feet again. If a successful *modus operandi* can be evolved, one might look forward to steady if slow improvement which in so far as it provided the working classes with continuous employment would allow their household budgets to bespeak more sugar. Sugar consumption is very much affected by the incidence of employment, for while sugar is a useful food, it is unfortunately one of the first to be knocked off by the average householder if funds will not suffice. We wonder how far the war has affected in Europe the tendency to use sugar in hot beverages; we believe it is the case that a very large number of children, aged 5 to 14 years during the past decade, have been brought up from force of circumstances to drink unsweetened beverages (i.e., tea and coffee) and may continue the acquired taste all their lives, which means a not inappreciable diminution in the sugar consumption.

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[1] See *I.S.J.*, 1921, 116.

Increasing Sugar Consumption by Advertising?

In view of the above, we think it is no fantastic idea to suggest that sugar producers may in the end have to combine to carry out an advertising campaign to extol the virtues of sugar, much on the lines on which certain other suppliers of commodities (for example gas companies and the makers of gas-burning utensils) have combined to advertise in an attractive manner the utility of their products.

Certainly in the United Kingdom of late years nothing has been done comparable with American practice to advertise sugar as a distinct food. We do not recollect ever seeing such public appeals at any time the last twenty years. Yet we incline to think the advantages of advertising sugar, as an aid to increasing the consumption in this country, are greater than the objections, and the producers' interests may yet find it advisable to make the attempt. Certainly the present consumption of sugar in this country is much lower than it should be. There are of course other reasons than unacquired taste to account for the deficiency. The heavy duty on sugar—now 2¾d. per lb. as compared with about ½d. in pre-war days—is a serious handicap, inasmuch as it more than doubles the cost of the article by the time it reaches the consumers' table; a reduction even by ¾d. per lb. might effect some improvement in the consumption, and if it be the case that a General Election is contemplated next month, the electors *qua* consumers ought to bestir themselves and endeavour to get some alleviation in the matter of this taxation; what the Exchequer loses pro rata it may yet get back by an increased consumption. The U. K. consumption ought to be round about two million tons annually instead of the 1,440,363 tons given in the Board of Trade statistics as the consumption figures for 1921.

The drawback of unemployment is certainly also a factor in restricting consumption in this country, but it is bound to be a diminishing one, as with the fall in the cost of living and a better trade outlook, there ought to be less poverty during 1922 than in the year just ended. Opinions differ as to the rapidity of trade revival in the United Kingdon, but most authorities seem agreed that we have reached the worst by now and can look for better times even though these only come slowly on the scene. The general tendency to reduce wages all round will cheapen the cost of production and render easier the acquisition anew of overseas markets, all of which will lead to steadier employment than has been experienced during 1921. For these reasons we look forward to the 1922 consumption of sugar in Great Britain exceeding that of 1921.

Preliminary Work of the Sugar Research Association.

The Sugar Research Association is starting a series of investigations into Empire sugar problems, beginning with the West Indies. Operations will be on a modest scale to begin with, but may be expected to develop in a larger way at no very distant date. The Association has formed a small Directing Committee to carry on the work of research, consisting of Sir Edward Davson (Chairman of Council), Mr. W. Martineau, Mr. A. D. Jackson, Mr. R. Rutherford, Mr. W. Scott Herriot, Mr. Harold T. Pooley (Hon. Secretary).

Notes and Comments.

The Committee has been particularly fortunate in securing the co-operation of **Sir Francis Watts**, K.C.M.G., C.M.G., D.Sc., to direct the work of the Research Chemist in the West Indies, and of Professor **Brereton Baker**, C.B.E., D.Sc., to act as Chemical Adviser to the Association. The Research Chemist, Mr. **R. G. Farnell**, A.R.C.S., A.I.C., after a brilliant University career in chemistry, has been a Research Chemist to Messrs. **Brunner Mond** & Co.; he then engaged upon research work under Professor **Baker**; and carried on special research in organic chemistry under Professor **Perkin** of Oxford. Mr. **Farnell** will during the next few months study the work of the Sugar School at Glasgow under Dr. **Gray** and Mr. T. H. P. **Heriot**, and after working with Professor **Schreiber** in London on the important question of Colloids, will proceed to the West Indies to begin his work of investigation.

Members of the Association and other Empire sugar producers are cordially invited to propound any problems with which they meet for the consideration of the Directing Committee, in order that investigation may be directed to them if feasible.

The Classification of Sugar Canes.

On a recent page of this Journal[1] we drew attention to an annotated list of sugar cane varieties compiled by F. S. **Earle**. This writer has, in correspondence arising out of our abstract of his paper, appealed for the help of all workers in the shape of criticism and correction of his list, and has especially drawn attention to his incomplete knowledge of the literature dealing with the many Indian varieties. He has complained that, in spite of repeated search in the New York libraries, he was unable to secure a copy of the latest work in the classification of the difficult and little known Indian varieties of cane, which are now coming into prominence in various sugar growing countries. As a first step in the direction desired by **Earle**, we reprint on another page of this issue a preliminary classification of Indian canes collected at the Cane-breeding Station at Coimbatore for the double purpose of providing parents for the crossed seedlings and for a fuller morphological study of Indian canes. We thus give a wider publicity to this initial attempt. In a short preface added by the compiler of this classification, it is made clear that this effort is merely of a preliminary character, as there is much further work to be done by students actually in the country both with regard to the varieties mentioned and the many others not included. We trust that this work will be taken up in the near future in consideration of its importance both to the Indian sugar industry and to those elsewhere interesting themselves in Indian canes. We likewise trust that the larger and more difficult matter of the synonymy of the older canes of the tropics will not be lost sight of, and that those who are in the position to give authentic details and corrections to **Earle**'s list will continue the work so usefully begun by this writer and especially by **Noël Deerr**.[2] We shall always be willing to give such publicity as is possible in our pages to work of this character, and trust that those who have useful information to impart will send it along. We shall welcome all except contributions of excessive length, providing they help to add to our knowledge of this subject.

Sugar Growing in Malaya.

In his report for 1920, Mr. L. **Lewton-Brain**, Director of Agriculture in British Malaya, refers to the efforts that are being made to encourage the cultivation of sugar cane in the Malay Peninsula.

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[1] *I. S. J.*, 1921, pp. 450-451.

[2] *Cane Sugar*. Noël Deerr. Revised Edition, 1921, Chapter IV.

With the high prices ruling for sugar, the question of reviving the industry has received a certain amount of attention during the period under review, and applications have been made for large areas of land for the purpose of taking up the cultivation of sugar as a sole crop. A Committee was formed to investigate the matter and report to Government as to the advisability of granting facilities for the cultivation of sugar, with a view of re-establishing the industry on a permanent basis. With the help of the Agricultural Inspection Division, a collection was made of local sugar canes from the different districts throughout the Federated Malay States and Straits Settlements, and these were planted at the Experimental Plantations, Kuala Lumpur. An effort was also made to introduce the best types of canes which are now being grown in all the more important sugar-growing countries in the tropics, and the planting materials were expected to arrive early in 1921. Land is being offered at special terms for sugar cane cultivation, and suitable areas are being reserved.

Apart altogether from the question of encouraging the cultivation of sugar for export, there would appear to be reason for believing that a good market could be found for locally-grown sugar, provided facilities existed for refining the crop. The statistics for 1919 of the Straits Settlements show that 97,340 tons of sugar, valued at £3,815,976, were imported into the Colony mostly from Java and other parts of the Dutch East Indies. Of this quantity 65,988 tons were exported, of which 13,051 tons were sent to the Federated Malay States and the other Native States in the Peninsula. The trade statistics of the Federated Malay States give the imports of sugar as follows over a period of three years: 1918, 8194 tons, value £147,781; 1919, 9893 tons, value £383,021; 1920, 7379 tons, value £530,700.

The British Guiana Sugar Planters' Experiment Stations.

It will be remembered that in 1919 the Sugar Planters Association of British Guiana obtained Government legislation with a view to compelling all proprietors of sugar estates in that colony to co-operate in establishing an experiment station to continue and augment the classical investigations on sugar cane carried out previously by Professor HARRISON at the Botanic Gardens. The first contribution of the estates was assessed at 33 cents per acre, and with the funds provided the Committee of Management took steps to start a central station near Georgetown to carry on the work of investigation referred to above. Land of the ultimate extent of 110 acres was gradually acquired on an abandoned sugar estate—Sophia—belonging to Messrs. CURTIS, CAMPBELL & Co., and on it were erected the necessary buildings, which were opened by the Governor on June 21st, 1920.

The following month a large number of different varièties of cane growing in the canefields of the Botanic Gardens were cut and the tops planted out at Sophia with the object of extending as rapidly as possible certain selected varieties and trying them out on a larger scale and under different conditions. Some 640 varieties were thus obtained covering about 11 acres, in addition to about 2000 selected seedlings raised in 1919. The raising of new seedlings from arrows is likewise being pushed forward both at Sophia and at the Botanic Gardens. And, finally, Experiment Stations in other cane growing countries have been applied to to send tops of their most promising cane varieties for trial in Demerara.

For the purpose of manurial and cultural trials, however, it is proposed to establish branch stations on the estates, the soil of the experiment station (which has lain fallow for 25 years) being too rich to give average estates soil conditions. This also applies to trials with mechanical tillage.

It is intended ultimately to acquire a Laboratory and staff, but till that exists the Government has placed the laboratories of the Department of Science and Agriculture at the disposal of the Experiment Station workers.

The above facts are gleaned from the Annual Report of the Stations, which, though prepared last January, was only published in October. The balance sheet shows a profit of $2662 for the year ending September, 1920; the greater proportion of the money expended ($19,895) was spent in bringing new land into cultivation and cannot be regarded as expenditure on actual experiment station work; the cost of clearing Sophia proved exceptionally heavy, and in view of the continuing heavy costs of establishing the station, the Committee have assessed the planter's contribution for the current year at $1 per acre. It is, however, so desirable that this work should be continued in the interests of the agricultural side of the British Guiana sugar industry, that we are sure the vast majority of the planters will contribute cheerfully to the venture.

Some Greenock History.

The year 1921 (says the *Greenock Telegraph*) saw the end of the Greenock Sugar Exchange as the market for Clyde refined sugar. In recent years its decline as a distributing centre has been gradual but sure, and now all the local refiners have their salerooms in Glasgow, where the headquarters of the refined brokers' trade has always been. The Greenock Sugar Exchange was opened in 1857, and for many years the dealers from Glasgow attended every morning, saloon carriages being provided for them on the Caledonian Railway. Animated was the scene and keener the competition in the half hour between the arrival and departure of "the brokers' train," for many transactions were carried through involving large sums of money. The business was done on the spur of the moment and by word of mouth, and it says much for the acuteness and integrity of all concerned that such deals were always implemented to the letter and honoured to the bond. Of those constituting the members of the Sugar Exchange in its earlier days but two refining firms now remain—Messrs. John Walker & Co. and Neill, Dempster & Neill; and of the refined sugar dealers Messrs. Smith & Sharp, of Glasgow, alone survive. Although shorn of its importance as a refined sugar market, the local Sugar Exchange still continues to be the mart for raw sugars, and the meeting place for merchants and refiners.

The same paper, it may be added, gives the meltings of Clyde refineries for the past three years as: 1921, 180,000 tons; 1920, 218,000 tons; 1919, 259,600 tons. The drop in the 1921 output was due mainly to the coal strike which caused a general suspension of work for two and a half months, also to the competition of the final stocks of Government-owned white sugar. In 1902 the meltings amounted to only 123,400 tons, but in 1881 were as high as 264,800 tons.

ERRATUM.—In the article on "The Selection of Engine Sizes for Cane Milling Plants," which appeared in our last issue, one of the formulae was reproduced wrongly, owing to a misreading of the manuscript. In the third paragraph from the end, the sentence "These formulae reduce to the form $d = K \frac{3}{n f}$," the form should have been given as "$d = K \sqrt[3]{n f}$," the intention being a cube root and not a fraction.

Fifty Years Ago.

From the "Sugar Cane," January, 1872.

A contribution of considerable interest to the chemist appeared in this issue, being a translation from the *Vereinszeitschrift*. This was the well-known paper by **Wackenroder**, describing experiments carried out with the object of obtaining more definite information on the matter of the loss of sugar occurring during refining than existed at that time. It was shown that during the boiling of pure solutions of sugar a loss of sucrose occurs; but the investigator named discovered the very interesting fact that often after boiling in the refinery an increase of polarization is actually to be observed. Many instances of this were recorded, though sometimes there was a decrease, depending upon the purity of the products concerned. In the case of massecuites of high purity, the polarization per 100 of dry substance was found to be generally less than that of the syrups from which they originated. On the other hand, with massecuites resulting from rather impure syrups or molasses nearly always an increase in the polarization was indicated. This increase of polarization was attributed by **Wackenroder** to the formation of dextrin-like substances having a high dextro-rotation, substances which therefore are capable of masking the loss which might occur during evaporation and boiling as the result of decomposition, inversion, or entrainment.

It may here be mentioned that later **von Lippmann** carried out a very thorough investigation into the question of the losses that may occur in refining. He found a total loss of 2·82 per cent. of the sucrose introduced into process, 31·08 per cent. of which was determined (having occurred in the sweet-waters and in the char); while 68·92 per cent., that is 1·94 per cent. of that introduced, was undetermined. But this undetermined loss could be explained. It was due to the repeated boilings taking place in the course of refining under the particular conditions of working, though it could not be detected entirely by means of the polarization of the various products, owing to the so-called "super-polarization" pointed out by **Wackenroder** in this valuable research.

Two other papers published in this number of our predecessor may be mentioned more briefly. **Casamajor** in an article originally appearing in the *American Chemist* described experiments which he considered proved that animal charcoal does not absorb sugar from its solutions when used in the laboratory for the decolorizing of solutions for polarization. His view was that previous workers, Dr. **Stammer** for example, had not dried the char sufficiently, and that therefore a lower polarization of the solutions treated was recorded. Modern opinion, however, appears to be that absorption of sucrose from alkaline, and especially from acid solution does occur both in the case of animal charcoal and also of decolorizing carbon.[1] In another paper, also reproduced from the *American Chemist*, Dr. I. **Walz** discussed the question of the temperature at which animal charcoal should be dried for its determination of its water content, a matter which (it will be remembered) had previously been investigated by Dr. **Wallace**.[2] **Walz** advised heating for one hour at 250°F. (121°C.), or by leaving the char in a desiccator over sulphuric acid for 24 hours, and he pointed out that if a temperature higher than 250°F. be used and if heating be sufficiently prolonged an increase of weight takes place, probably as the result of the oxidation of certain of the constituents.

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[1] *Cf.* **Pellet**, *I.S.J.*, 1916, 571.

[2] *I.S.J.*, 1919, 429.

The Sugar Trade during 1921.

Messrs. William Connal & Co.'s Annual Review.

Below will be found some lengthy extracts from the annual report issued by Messrs. William Connal & Co., the well known Glasgow sugar brokers, on the Sugar Trade during 1921.

The rapid and sensational advance in the American sugar market during the early months of 1920, followed by an equally rapid and unexpected decline during the remainder of the year, was the ultimate cause of wide-spread disaster. During the height of excitement many Americans, to provide against an unexpected sugar famine, purchased, regardless of cost, the surplus stocks in all the world's markets, and these purchases, shipped from 55 different ports, kept arriving in America during the latter months of the year. As the market had then suffered a severe decline, the losses incurred became the cause of much financial ruin and distress. Dealers likewise found themselves burdened with large invisible supplies, at the time unsaleable, which prevented their availing themselves of the cheaper sugars then obtainable. When, therefore, the market opened in January it was stocked not only with about 100,000 tons carried over from 1920, but also with the invisible supplies in the hands of dealers.

The first arrivals of the new Cuban crop had been somewhat delayed by unfavourable weather, but, when offered to the market in January, they met with a poor response, and the early sales made were at 4½ cents., cost and freight, New York, the equivalent of 28s., and thereafter at 4⅜, the equivalent of 26s. These prices proved deeply disappointing to planters, who found them quite insufficient to cover the expense of the cultivation of their crop. There was then a market for a portion of their sugars, as they arrived in Japan and France, yet demand was not sufficient to maintain prices, and, at the close of the month, 3½ cents. had to be accepted, cost and freight, New York, the equivalent of 20s. 5d. There were rumours then current that, on account of heavy rains in Cuba, scarcity of labour, and insufficient transport, the crops would be adversely affected, and might not exceed 3,300,000 tons, perhaps not even 3,000,000 tons. These rumours imparted a slightly firmer tone, and, early in February, 4 cents., cost and freight, New York, was obtained, the equivalent of 23s. 6d. The market was then further strengthened by a purchase by the British Royal Commission of 100,000 tons at 4 cents., f.o.b.

As America and Cuba had become the great emporiums for the supply of the world's wants, their movements were followed with deepest interest. In February so serious had the financial condition of Cuba become, where a moratorium still existed, that, under arrangement with General CROWDER who had been appointed special envoy for the examination of the Cuban position, President **MENOCAL** appointed a committee of seven influential experts—three Cubans and four Americans—to control the sale and shipment of the then unsold portion of the crop, that the industry of the Island might be preserved. On the confirmation of the appointment of this committee there was a firmer tone, and towards the middle of February business was done at 4⅞ cents., cost and freight, New York, the equivalent of 27s. 11d.

On 28th February, the British Royal Commission on Sugar Supply brought its business for the purchase of raw sugar to a close. A special agreement was, however, made with refiners, that although they were at liberty to make what purchases of raw sugar they desired, yet these they could not use, until the Government stocks had been exhausted, and it was then estimated that these stocks might last till September.

In March the Cuban Commission obtained 4¾ cents c. and f., for their sugars, and it was understood that it was their intention to maintain their selling price during the season at 4¾ to 5 cents. During March and first half of April they were successful in doing so, and occasionally obtained 5¼ cents., cost and freight, New York, the equivalent of 30s. An easier tone, however, was then developed, when 26s. 6d., c.i.f., United Kingdom, was accepted for sugars in quantity.

At the close of April there was a severe relapse, on dull American markets, and extreme apathy on the part of buyers, and 3⅞ was then accepted, cost and freight, New York, the equivalent of 21s. 10d.; and this remained the quotation till the close of May.

The American beetroot crops had been produced at a high cost in the hope of arriving at a favourable market, but the slump in prices which had taken place proved deeply disappointing, and fabricants as well as agriculturists anxiously hoped for the passing of the Emergency Bill then before Congress, as, if passed, the bounty they had enjoyed of 4s. 7d. per cwt. would be raised to 7s. 4d. per cwt. To their extreme satisfaction this bill became law early in June.

The American market continued to droop during the next three months, June, July, and August, trade was unsettled and unemployment prevalent, and Cubas, which, early in June, were quoted at 3¼, remained with unimportant fluctuations at this figure till the end of August. In July and first half of August an improved demand was experienced for refined sugars. During previous months of depression dealers had reduced their stocks to a minimum, as their operations till then had resulted in continuous loss, but, on revival of demand, on new fruit arriving, and for the replenishing of exhausted stocks, there was an active market, with daily improving prices, which continued till the middle of August. It was then that Clyde refiners, in view of the exhaustion of Government stocks in September, made a beginning of the purchase of raw sugar for their own account, and they succeeded in securing a considerable quantity of Cuban, for early shipment, at 21s., c.i.f., Greenock. During August and September the Cuban quotation was maintained at about 3·25, cost and freight, New York, the equivalent of 19s. 9d., but the Commission preferred to offer their sugars sparingly in the hope of commanding the market when supplies from Porto Rico and other American colonial sugars came to an end. There was, however, a continuous arrival of these sugars during these two months, which were moved off at about 4·50, c.i.f., the duty paid equivalent of 2·90 for Cubas. On 30th September Clyde refiners completed their melting of Royal Commission sugars; during the seven years of their work for the Government they had melted in all 1,565,000 tons of raw sugar.

It became evident in October, as centrals were closing with out-turns better than original estimates, that the Cuban crop was likely to prove about 4,000,000 tons, and having this in view, the Cuban Commission reduced their selling limit to 2⅝, cost and freight, New York, the equivalent of 15s. 7d., followed by a further reduction to 2½, at which they were enabled to make considerable sales to American refiners. At the same quotation of 2½, but with an improving American exchange, it became possible to make considerable sales to both British and French buyers at 14s. 9d., c.i.f. At the close of November a further improvement of exchange admitted of business being done for export at 14s. 6d., and shortly afterwards 14s., c.i.f.

At the end of November a petition was presented to the Cuban Senate requesting the dissolution of the Cuban Finance Commission, on the plea that its purpose had not been fulfilled, seeing that, at its formation in February, 5 cents was the value of Cubas, but now only 2½, and that about 1,600,000 tons of the crop remained unsold. From uncertainty as to the continuance of the Commission, and with a still improving exchange, Cubans were offered early in December at 13s. 6d., c.i.f., at which several cargoes were taken by London refiners, and afterwards, when 2 cents were accepted for new crop, cost and freight, New York, the equivalent of 10s. 11d. at 4·10 exchange, there were sellers at 12s., c.i.f., but buyers preferred to await further developments. On 22nd December, when the Cuban President signed the petition for dissolution of the Cuban Commission on 31st December, there was some pressure to sell at 11s., c.i.f. At the close the market was easier, and business has been done at 1·75, cost and freight, New York.

All control, therefore, of the sale of about 1,200,000 tons of old crop sugars will have ceased on 31st December, and owners will then be at liberty to dispose of them as best they can. When the cost of producing the crop, just closed, is taken into consideration—expensive labour, inflated prices for material, and supplies—all of which have been estimated to involve an average price of 5 cents.—namely, of 23s. per cwt., and, as it is likely that half the crop may not realize more than 2 cents., or 10s. 3d. per cwt., it will be realized how serious the loss must be to the Cuban planter. Looking to the future, it should not be forgotten that, whereas this year was commenced with large invisible supplies, it ends with the trade working from hand to mouth, and should any feeling of confidence arise at present low prices, and should dealers in consequence resolve to hold their accustomed stocks, a great absorption of present visible supplies would rapidly take place.

There has been a better opening during the year in the Eastern markets for the produce of Java, Mauritius, and other countries than in the United Kingdom, and it is known that at least one cargo of Mauritius sold for this country has been directed to the east, and has been replaced by western sugars.

During the advancing prices last year many planters were induced to re-equip their factories, and to extend their cultivation, and many others to make purchases of estates at extravagant prices, in the hope of the continuance of high prices, but the low level to which the market has now fallen has proved to all such parties grievously disappointing, and their crops, produced at last year's inflated costs, have resulted in immense loss.

British Beetroot Crops.—The Cantley factory, in Norfolk, expects to produce this season about 4000 tons of fine granulated sugars of excellent quality, which has brought a good price in the London market. It has received increased support from the growers in Cambridgeshire, Norfolk, Suffolk, and Essex, and has obtained nearly twice the weight of roots compared with the receipts of last year.

The Kelham factory, in Nottinghamshire, commenced work in their new factory this season, but their results, to date, have been far from satisfactory. It could scarcely be otherwise, with roots costing them £4 per ton, and the cost of the factory loading it with an overwhelming debt.

Refined.—Five refineries have been at work in Greenock during the year. The refinery of the Brewers' Sugar Company has been dismantled, the site having been acquired for shipyard extensions, and their business has now being amalgamated with the Manbre Sugar and Malt Company, of London. Melting was suspended in all the refineries during the coal strike, from about the end of April till early in July. This stoppage and a shortage of raw sugars in November and December have accounted for the total melt for the year having been only 182,878 tons, a reduction of 34,029 tons as compared with the previous year.

During January and February when under Government control, the price of granulated was 72s. per cwt. duty paid, and this was continued till the last week of control, when it was reduced to 67s. 6d. Free sugars in this period realized the same price as was paid for Government granulated. On decontrol of the article on 28th February, there was a fall of 1s. in Greenock granulated, and the price of American was then 38s., c.i.f. These easier prices were of short duration, and were followed by a gradual improvement until the middle of March, when the price of Greenock fine granulated was 68s. 6d., duty paid, and of American 40s. 6d., c.i.f.

The coal strike in the United Kingdom, and the consequent unemployment, together with the huge Cuban stocks, brought down prices rapidly, until at the beginning of July 27s., c.i.f., was the value of American granulated. Greenock sugars were not then available, the refineries having been off work all May and June. At the expiration of Government control, the Royal Commission had large stocks of Canadian and American granulated in warehouses in Glasgow, and these stocks were largely drawn on during the coal strike. There was a great increase in demand when the strike ended, as stocks in the hands of dealers had been practically exhausted, and this imparted firmness to the market, and prices advanced each week, until at the middle of August 31s. 6d., c.i.f., was paid for American granulated, and Greenock fine granulated was then quoted at 60s. 6d., duty paid.

From this date till the close of the year there was almost constant sagging of prices, and at the close Greenock fine granulated is quoted at 45s. 3d., duty paid, and arrived American at the equivalent of 19s., c.i.f. Quotation for the latter for January-March shipment is 17s., c.i.f. Weakness in the American markets and pressure to sell was the cause of this great decline.

For the past six months dealers have been very cautious in their purchases, aiming to have as small stocks as possible, and they have generally been willing to pay a premium on Greenock sugars over the price of foreign, for shipment, as the former are immediately available and can be quickly distributed, whereas in purchases of foreign they have to run the risk of the market till the sugar arrives. In this way they have eliminated, or at least reduced, their risk of loss on a falling market. From the same reason Continental sugars have commanded relatively better prices than American, but generally only for the East Coast ports of the United Kingdom, to which the passage has been more rapid, and freights cheaper from the Continent.

The arrangement by which 500,000 tons of unsold Cuban sugars are to be shipped to U.S.A., refined there on a toll basis,[1] and the refined product to be exported, will ensure a large supply of American granulated available for the United Kingdom during the next eight months, but, as there are practically no invisible stocks in existence here, and as France is expected to be a buyer, there may not be any difficulty in absorbing it at the low level of prices now ruling. Much depends on the out-turn of the Cuban crop just commenced. Should it prove to be about a million tons short of the previous crop, from difficulty in financing harvesting operations, this large prospective supply may be readily absorbed.

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[1] This basis is said to be a price of 2 cents per lb. in bond and a tolling charge of 0·9 cents per lb.—Ed. *I.S.J.*

The Future of Sugar in the West Indies.

Now that the inflation of ideas and prices due to the war has passed away and a calm dispassionate view can be taken of the position, it may not be amiss to consider what the future of the sugar industry in the British West Indies will be, and to what extent those Colonies will contribute to the world's supply of sugar.

The premier as regards sugar production of those Colonies has been for many years British Guiana, which of late has contributed about 40 per cent. of the total British West Indian production. It is, however, with regard to this source that the most depressing view must be taken of the future. Readers of the *International Sugar Journal* will remember that the unhappy position of the British Guiana sugar industry as regards soil, factory and labour conditions has been set forth in the articles "Labour in British Guiana"[1] and "The British Guiana Sugar Industry,"[2] and as the present low prices will eventually continue for some time, and there is no prospect of the inflation which has from time to time kept the British Guana sugar industry going, the weaker of the estates are bound to go out of cultivation, and only the fittest survive, their exodus being hastened by many of them having fallen into the hands of local syndicates formed at the time of the war prices, which with the aid of the local banks paid extravagant sums for them, and which will be quite unable to carry on in the face of the prospective lengthened continuance of exceptionally low prices. It may indeed be safely concluded that in a comparatively short space of time not more than 50,000 tons from the survivors of the estates will be produced, the ability to survive being not only due to natural causes, but to more efficient machinery and easier labour conditions arising from the diminution in sugar cultivation and production.

Although to some extent what has been above said as regards British Guiana is applicable also to Trinidad, the sugar industry of that island is in a stronger position, inasmuch as a large proportion of its sugar is produced from farmer's canes. It suffers, however, as British Guiana has suffered in the past, from being largely dependent upon outside capital, the suppliers of which, whether in the form of individuals or companies, want their "pound of flesh," a position not conducive to real prosperity. The future, therefore, of the Trinidad sugar industry depends very largely on the small farmer, who in times of low prices may prefer to grow other produce than the sugar cane. The cacao and oil industries of Trinidad also help indirectly to support the sugar industry to a far greater extent than rice does the British Guiana industry. Taking all things into consideration, the future output of sugar in Trinidad will probably be not much below the present, say 40,000 tons.

The position of sugar in Barbados is, as it always has been during the 250 years in which the cane has been cultivated in that island, sound. Its strength has always been in its small land holding, coupled with a large population; and although of recent years a considerable amalgamation has taken place as regards manufacture, the bulk of the canes are still grown by comparatively small, mostly resident proprietors. The result of this has been that Barbados has never been dependent to any extent on outside capital. Its climatic and soil conditions are also in its favour. Its present output, every available acre being in cultivation, is about 50,000 tons of sugar if syrup for the Canadian market is made in addition, or 70,000 tons if it is not.

Recent official reports from Jamaica give the probable future sugar output of that Island as being 60,000 tons, which is an advance on its present production.

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[1] *I.S.J.*, 1919, 166. [2] *I.S.J.*, 1920, 375.

Competition has to be faced in Jamaica with the banana industry, which is a simpler proposition than sugar, and it seems particularly certain that, unless anything occurs in the banana market, the above figures for sugar output will be the maximum.

In Antigua the present output of 15,000 tons will probably be sustained, as the bulk of the industry is run on sound co-operative lines, and is well equipped as regards machinery. In St. Kitts there will probably be an extension of sugar as labour returns to the island, and is settled on the land under a Government Settlement Scheme; and 20,000 tons may be looked for. Grenada is fully occupied with cacao; but it is possible that there may be sugar development in St. Vincent to the extent of 10,000 tons, as the settlement of the peasantry on the land is progressing satisfactorily. For many reasons St. Lucia is not likely to exceed her output of 5000 tons. The physical and labour conditions of that island are against sugar and the attention which is now being paid to agriculture is directed more to cacao and limes than to sugar. Nothing may be expected from Dominica for similar reasons.

In British Honduras a very small sugar industry has been established for some time. Labour conditions and the profitable exploitation of other industries, such as timber, chili and bananas, are against sugar. Its sugar production is, and will be, negligible.

The future output of the British West India Colonies will not therefore probably exceed:—

British Guiana	50,000 tons
Barbados	50,000 ,,
Jamaica	60,000 ,,
Leeward Islands	35,000 ,,
Windward ,,	15,000 ,,
Trinidad	40,000 ,,
Total	250,000 tons,

which is about the extent of the sugar production of Mauritius.

The claim of British Guiana to an ability of production of 2,000,000 tons of sugar has not been taken into account in the foregoing. It is based on there being large areas of soil in the interior of that colony which are, as well as the climatic conditions, admirably suited for sugar. But anyone acquainted with the economic conditions of British Guiana will recognise that the development of a sugar industry in its hinterland is outside of practical politics. There are no suitable means of communication with these very difficult of access lands of the interior for transfer of machinery, sugar, stores, etc., and there is practically no population from which labour could be drawn. No capitalist would attempt sugar production where he has to import all the labour from the East, and construct railways for the produce, when in Western Africa there exist large tracts of well populated land suitable for sugar growing easy of access from the coast. Besides, more sugar is not wanted in the extra-Continental Western Hemisphere, and what is wanted on the Continent will be supplied by the Continent itself.

For many reasons it is a better policy for the British West India Islands not to attempt to increase their sugar output, but to devote their attention to the settlement of the peasantry on the land, and thus check the migration of labour, which annually takes place, to the increase in existing, and the establishment of further agricultural industries other than sugar, and the perfecting of the existing systems of cane supply and manufacture.

The Calorific Value of Bagasse.

By P. H. PARR.

It is desirable at times to know, with fair accuracy, the calorific value of bagasse; for instance, when a new sugar factory is being designed, the steam consumption can be estimated, and then the question arises as to whether or no the bagasse will be capable of supplying all of the steam required. If the bagasse shows a deficiency of steam-producing power, expensive auxiliary fuel will be required, in which case every effort must be made to conserve steam, and one or more boilers should have furnaces specially designed to burn the auxiliary fuel to the greatest advantage. If there is an excess steam-producing power, then elaboration of apparatus for the sake of steam conservation is not only a waste of money, but leads to further continual expense in disposing of the uselessly saved bagasse. The most desirable balance is naturally that where the bagasse is sufficient to provide all of the steam required in the factory, with a slight, but not great, surplus; this, unfortunately, cannot always be obtained, but a great deal can be done by the use of every means of saving steam when the calorific value of the bagasse is deficient, and by heavy maceration, and no particular attempt to save steam, when it is in excess.

For present purposes, bagasse may be taken as consisting of fibre, sugar, and moisture, the two former being the combustible part, and the first question is as to their individual calorific values. Various determinations have been made and published, but the differences are quite considerable, and the writer prefers a calculated value. The old Welter rule of taking the oxygen as being in combination with the hydrogen as water is of course quite useless for such compounds as sugar or cellulose, but by considering it as in combination with the carbon as carbon dioxide, results in close agreement with calorimetric tests are obtained. This means that the calorific value, in B.Th.U. per lb., of a fuel containing carbon, hydrogen, and oxygen, is given very closely by—

$$\text{U/lb.} = 62{,}000\ \text{H} + 14{,}500\ (\text{C} - \tfrac{3}{8}\ \text{O}) \qquad (1)$$

U being written for B.Th.U.

For sugar, $C_{12}H_{22}O_{11}$, we have 42·1 per cent. C, 6·4 per cent. H, and 51·5 per cent. O, so that—

$$\begin{aligned}\text{U/lb.} &= 62{,}000 \times 0{\cdot}064 + 14{,}500\ (0{\cdot}421 - 0{\cdot}375 \times 0{\cdot}515)\\ &= 7274\end{aligned}$$

which figure is a little over 2 per cent. too high. Probably the most accurate value is that given by the U.S.A. Bureau of Standards, S.P. 230, which is 3949 ± 2 calories per grm., or say 7108 ± 4 U/lb.; but as there are no equally reliable determinations for fibre, calculated values will be used throughout this article, as giving uniform results, probably about 1·5–2 per cent. in excess, which error is negligible for present purposes.

For fibre, the first question is as to the composition, which is slightly variable. Brown and Blouin give 55 per cent. cellulose, $C_6H_{10}O_5$; 20 per cent. xylan and 4 per cent. arabin, both having the same formula as cellulose; 15 per cent. lignin, $C_{24}H_{26}(CH_3)_2O_{10}$; and 6 per cent. acetic acid, $C_2H_4O_2$. From this, the ultimate composition works out to 46·84 per cent. C, 6·245 per cent. H, and 46·915 per cent. O. Geerligs gives 47·68 per cent. C, 6·48 per cent. H, and 45·67 per cent. O. For the present it will be assumed that the ultimate composition of fibre averages 47·0 per cent. C, 6·3 per cent. H, and 46·7 per cent. O, for which the formula gives a calorific value of—

$$\begin{aligned}\text{U/lb.} &= 62{,}000 \times 0{\cdot}063 + 14{,}500\ (0{\cdot}470 - 0{\cdot}375 \times 0{\cdot}467)\\ &= 8183.\end{aligned}$$

The calorific value of bagasse at NTP (freezing point and atmospheric pressure) is thus—

$$\text{U/lb.} = 8183 \times \text{fibre} + 7274 \times \text{sugar}. \qquad (2)$$

An air supply to the furnace of double the amount theoretically required, or 100 per cent. excess, may usually be considered satisfactory; it will be found that 1 lb. of fibre requires 1·290 lbs. of oxygen, or 5·609 lbs. of air, while 1 lb. of sugar requires 1·123 lbs. of oxygen, or 4·883 lbs. of air, and when burned with 100 per cent. excess, the resulting products of combustion are—

	FIBRE.		SUGAR.
CO_2	1·723	....	1·544
H_2O	0·567	....	0·579
O	1·290	....	1·123
N	8·638	....	7·520
Total	12·218	....	10·766

The heat available, with any particular temperature of the waste gases, is the difference between the calorific value of the fuel, plus the initial heat of the air and fuel above 32°F., and the heat contained in the waste gases at that temperature. According to LE CHATLIER, the heat contents per lb. of gases, between 32°F. and T°F., is—

$$U = (T - 32)\,[a + b\,(T + 952)\,] \qquad (3)$$

where *a* and *b* are as follow :—

	a.		*b*.
CO_2..	0·1481	....	0·0000469
O..	0·2036	....	0·0000104
N	0·2320	....	0·0000119
Air	0·2255	....	0·0000115

The results of this, together with the values for steam from Marks and Davis' Tables, are given in Table I, and we can now calculate the heat contents of the gases at various temperatures, and hence the amount of heat available. For example, assuming the normal temperature to be 80°F., and waste gases at 500°F., the heat contents of the gases from 1 lb. of fibre will be—

CO_2	1·723 ×	91·8	=	158
H_2O	0·567 ×	1237·0	=	701
O	1·290 ×	92·0	=	119
N	8·638 ×	105·0	=	907
Total				1885

and deducting this from the calorific value of the fibre, 8183 U/lb., gives 6298 U as the heat available per lb. of fibre. From this we may deduct 3 per cent. for ash, giving 6109, and then say 10 per cent. for radiation, etc., so that, finally, we may expect to have 5498 U per lb. of fibre actually absorbed by the water in the boiler. If we allow for feed water at 100°F. and a boiler pressure of 120 lbs. per sq. in., each lb. of steam requires 1124 U, so that 1 lb. of dry fibre should evaporate 5498/1124 = 4·88 lbs. of water.

Under the same conditions, the heat contents of the gases from 1 lb. of sugar will be 1751 U, leaving 7274—1751 = 5523 U gross; allowing 1 per cent. for ash leaves 5468 U, and 10 per cent. for radiation gives, finally, 4921 U net for absorption in the boiler, which will evaporate 4·37 lbs. of water. With gases at 500°F, the net calorific value of bagasse will thus be—

$$\text{U/lb} = 5498 \times \text{fibre} + 4921 \times \text{sugar} - 1237 \times \text{moisture},$$

and since moisture = 1·000 — (fibre + sugar), we have, finally,

$$\text{U/lb} = 6735 \times \text{fibre} + 6158 \times \text{sugar} - 1237.$$

For example, a bagasse having 47 per cent. fibre, 5 per cent. sugar and 48 per cent. moisture should give $6735 \times 0{\cdot}47 + 6158 \times 0{\cdot}05 - 1237 = 2236$ net available heat units per lb., which will evaporate $2236/1124 = 1{\cdot}99$ lbs. of water. If the cane had 12 per cent. fibre, the bagasse would be 25·5 per cent. of the cane, and the steam generation per ton of cane would be $2240 \times 0{\cdot}255 \times 1{\cdot}99 = 1137$ lbs., or say 114 gallons of water.

TABLE I.

°F.	O_2	N_2	CO_2	H_2O	AIR.
32	0·0	0·0	0·0	0	0·0
60	6·0	6·8	5·5	28	6·6
80	10·3	11·7	9·4	48	11·3
100	14·6	16·6	13·4	68	16·1
200	36·2	41·3	34·0	168	40·1
300	58·1	66·2	55·4	1192	64·3
400	80·1	91·3	77·8	1239	88·7
500	102·3	116·7	101·2	1285	113·2
600	124·8	142·3	125·5	1333	138·2
700	147·5	168·1	150·7	1380	163·3
1600	360·9	411·4	419·9	1827	399·8
1800	410·7	468·0	490·1	1934	454·9
2000	461·1	525·7	563·8	2047	510·9
2200	512·5	584·3	641·5	2167	567·8

Table II gives the calculated available heat for fibre and sugar, for different temperatures of the waste gases, when the air is at 80°F. and 100 per cent. excess air is supplied to the furnaces.

TABLE II.

Gases °F.	U/lb. FIBRE.			U/lb. SUGAR.		
	gross.	3 per cent. ash.	10 per cent. radiation.	gross.	1 per cent. ash.	10 per cent. radiation.
300	6922	6714	6043	6077	6016	5415
400	6612	6414	5772	5800	5742	5168
500	6298	6109	5498	5523	5468	4921
600	5978	5799	5219	5239	5187	4668
700	5656	5486	4938	4955	4905	4415

Table III gives the values of A, B, and C for use in the formula,

$$\text{Net U/lb.} = A \times \text{fibre} + B \times \text{sugar} - C, \qquad (4)$$

the net U's being the actual heat units available for absorption in the boiler, per lb. of bagasse, the air being at 80°F, 100 per cent. excess air, 3 per cent. ash on fibre, 1 per cent. ash on sugar, and 10 per cent. radiation allowance.

TABLE III.

Gases °F.	A	B	C
300°F.	7187	6559	1144
400	6963	6359	1191
500	6735	6158	1237
600	6504	5953	1285
700	6270	5747	1332
1600	4016	3748	1779
1800	3481	3275	1886
2000	2936	2792	1999

When economizers are not used, the boiler heating surface should be sufficient to bring down the temperature of the waste gases to between 500 and 600°F, say to 550°F.; when economizers are used, a smaller boiler heating surface may be installed, so as to give gases at 600-700°F, say 650°F, and the economizers should reduce them to about 350°F. For example, take a bagasse of 47 per cent. fibre and 3 per cent. sugar: without economizers the gases should be cooled to 550°F, and the net available heat (taking means between 500 and 600°F from Table III) per lb. will be—

$$6619 \times 0{\cdot}47 + 6055 \times 0{\cdot}03 - 1261 = 2032 \text{ U},$$

and the evaporation will be 1·81 lbs. of water per lb. of bagasse. With an economizer, and waste gases at 350°F, the net available heat will be—

$$7075 \times 0{\cdot}47 + 6459 \times 0{\cdot}03 - 1167 = 2352 \text{ U},$$

and the evaporation will be increased to 2·09 lbs. of water per lb. of bagasse: also, if the gases leave the boiler at 650°F, the heat absorbed by the boiler will be,—

$$6387 \times 0{\cdot}47 + 5850 \times 0{\cdot}03 - 1308 = 1869 \text{ U},$$

so that 2352 — 1869 = 483 U is to be absorbed by the economizer, which will raise the temperature of the 2·09 lbs. of feed water 483/2·09 = 230°F, from 100 to 330°F.

If desired, similar figures to those of Table III can readily be calculated for excess air amounts different from 100 per cent., but in the absence of special information, the foregoing basis will be found to give very good all-round results.

The figures in Table III for the high gas temperatures, are for estimating the furnace temperature, when the gases contain the whole of the heat value of the fuel, and there is no available heat. For our example bagasse, the net available heat at 1800°F is,—

$$3481 \times 0{\cdot}47 + 3275 \times 0{\cdot}03 - 1886 = -152 \text{ U},$$

showing that the furnace temperature is below 1800°F. At 1600°F we have,—

$$4016 \times 0{\cdot}47 + 3748 \times 0{\cdot}03 - 1779 = 221 \text{ U}:$$

interpolating between these figures, $1600 + \dfrac{200 \times 221}{221 + 152} = 1718$, say 1720°F, is the furnace temperature.

We can now find the mean temperature difference between the flue gases and the water in the boiler, and hence the probable evaporation per sq. ft. of heating surface. If Δ_0 is the initial, Δ_1 the final, and Δ the mean temperature difference, then, as usual,—

$$\Delta = \frac{\Delta_0 - \Delta_1}{\log_e \dfrac{\Delta_0}{\Delta_1}} \qquad (5)$$

For our bagasse, the boiler being at 350°F, and the exit gases without economizer at 550°F, we have $\Delta_0 = 1720 - 350 = 1370$, $\Delta_1 = 550 - 350 = 200$, so that $\Delta = 605$°F. The heat transmission for fire-tube boilers is about 5 U per sq. ft. per hour per °F mean temperature difference, and for water-tube boilers about 4 or 4·2 U: taking the former figure, we shall have a transmission of 5 × 605 = 3025 U per sq. ft. per hour, evaporating 3025/1124 = 2·69 lbs. of water. With an economizer, and gases at 650°F, the mean temperature difference is increased to 705°F, giving a transmission of 705 × 5 = 3525 U per sq. ft. per hour: also, the feed water being heated 230°F in the economizer, the heat absorption in the boiler per lb. of steam is reduced to 1124 — 230 = 894 U, and the evaporation per sq. ft. will now be 3525/894 = 3·95 lbs., allowing a reduction of about 30 per cent., in the heating surface. (It will shortly be seen that this is too much.)

For the economizer, we shall have $\Delta_0 = 650 - 330 = 320$, and $\Delta_1 = 350 - 100 = 250$, giving $\Delta = 284$°F, and the heat absorption per lb. of water per hour per °F mean temperature difference, must be 230/284 = 0·81. The writer finds that if this heat absorption be denoted by H, then the lbs. of water per hour per economizer tube of 10 sq. ft. surface, say W, may be taken as,—

$$W = \frac{0{\cdot}765 - H}{0{\cdot}00277} \qquad (6)$$

For our example, such a high value for H as 0·81 would give a negative value for W, showing that the proposed heat absorption in the economizer is impracticably great, and that the gases will not be cooled so low as 350°F. Let us try 400°F, then the net heat available will be found to be 2272 U, instead of 2352, giving an evaporation of 2·02 lbs. water per lb. bagasse: the economizer absorption must now be 2272 — 1869 = 403 U, heating the feed water 200°F: the mean temperature difference will be 324°F, calling for H = 200/324 = 0·618, and W = 53 lbs. of water per economizer pipe per hour. The boiler evaporation will now be 3525/(1124 — 200) = 3·82 lbs. per sq. ft. per hour. As one economizer pipe of 10 sq. ft. surface is to handle 53 lbs. of water per hour, and one sq. ft. of boiler surface is to evaporate 3·82 lbs. of water per hour, we must have one economizer pipe to each 14 sq. ft. of boiler; this gives a rather large economizer, and it will be better to increase the boilers a little, so as to give gases at a lower temperature than 650°F., and use a smaller economizer. If the gases from the boilers are taken at 600°F., and the waste gases at 400°F., then similar calculations to those given above show that the evaporation will be 2·02 lbs. per lb. of bagasse and 3·32 lbs. per sq. ft. of boiler surface; the economizer will heat the water 160°F. to 260°F., and must have one pipe for every 91 lbs. of water per hour, or per 27 sq. ft. of boiler surface. Taking a factory for 1000 tons of 12 per cent. fibre cane per 24 hours, there will be 10·6 tons of our bagasse per hour; without economizers this will evaporate 10·6 × 2240 × 1·81 = 43,000 lbs. per hour, requiring 43,000/2·69 = 16,000 sq. ft. of boiler surface in use; with economizers the evaporation will be 10·6 × 2240 × 2·02 = 48,000 lbs. per hour, requiring 48,000/3·32 = 14,500 sq. ft. of boiler surface, and 48,000/91 = 528 economizer pipes, the nearest standard being 544 pipes with 5440 sq. ft. surface, giving a total surface of 19,940 sq. ft. For water-tube boilers, the boiler surface should be about 20 per cent. more, or 19,200 sq. ft. without economizers; and 17,400 sq. ft with the same 5440 sq. ft. economizer surface, or 22,840 sq. ft. total. The same weight of 10 per cent. fibre cane, giving similar bagasse, would give 8·85 tons per hour of bagasse, evaporating only 36,000 lbs. without economizers and 40,000 lbs. with, requiring 13,400 sq. ft. boiler surface alone, or 12,000 sq. ft. boilers and 4480 sq. ft. economizers, a total of 16,480 sq. ft.; any further steam required must be provided for by boilers arranged for burning auxiliary fuel. It will be noticed that calculations made in the manner indicated above give results in very close agreement with practical working, and that without any forcing whatever of any of the arguments; so that a very good idea can readily be obtained as to the probable surplus or deficiency in any case of the bagasse for steam generation.

In this connexion, a few figures for wood, which is the usual auxiliary fuel in sugar factories, may be of value. Taking air-dried wood as containing 25 per cent. moisture, the average composition is about 37·5 per cent. C, 4·1 per cent. H, 33·4 per cent. O, and 25·0 per cent. H_2O: equation (1) gives a calorific value of 6167 U/lb.; 1 lb. requires 4·322 lbs. of air, and when burned with 100 per cent. excess gives as products of combustion,—

CO_2	1·375 lbs.
H_2O	0·619 ,,
O	0·994 ,,
N	6·656 ,,
Total	9·644 ,,

The furnace temperature is 2100°F., and the net heat units available, allowing 1 per cent. for ash and 10 per cent. for radiation, are as follows :—

Gases. °F.	U/lb.
300	4442
400	4221
500	3996
600	3768
700	3537

from which similar calculations to those for the bagasse can also be made for the auxiliary wood fuel.

When using economizers, it must be remembered that the gases are less in volume and lower in temperature. For the 1000-ton factory in the example above (12 per cent. fibre), the volume of the gases at 550°F. would be about 75,000 cub. ft. per minute, for which an 8 ft. 6 in. dia. chimney would be suitable, and for ¾ in. (water) draught would need to be 120 ft. high. With economizer, and gases at 400°F., the volume would be 62,000 cub. ft. per minute, calling for a 7 ft. 9 in. dia. chimney, with a draught of 1 in. (0·75 in. for the boilers and 0·25 for the economizer), necessitating a height of 200 ft., or else induced draught fans.

The Classification of Indian Canes.

During the cropping season of 1916 at the Cane-breeding Station of Coimbatore in South India an attempt was made to roughly classify the collection of indigenous Indian canes which had been accumulated during the three previous years. At each planting season it had been the custom to place such of them as had obvious resemblances next to one another. This had been fairly easy with the main groups Mungo, Pansahi, Nargori and to a certain extent with Saretha, but besides these there were a large number of unclassified forms which did not thus obviously claim relationship. Among the latter, as was natural, special attention had been attracted to the two large indigenous varieties of South India, *Cheni* and *Naanal*, for these were the only local Indian canes, and a number of seedlings were obtained from them during the first few years. In the course of their somewhat intensive study it soon became evident that they had allies in the collection hailing from every province in India, even extending to the minute canes of the Punjab, where they were represented by *Katha* and *Dhaulu of Gurdaspur* respectively. A full description of the groups founded by this study was afterwards published in a Memoir.[1] Some of the varieties in the two groups, which were named Saretha and Sunnabile after the best known forms, resembled each other as closely as did those in the Mungo, Pansahi and Nargori groups, while others were only brought together after a close study had shown them to possess in common a considerable number of minute characters of morphological importance. Thus the two groups instituted must be placed on a different footing from the three former ones, in that, disposed over a much wider area, time and their surroundings had to a varying extent obscured their close resemblance to one another. The classification which follows is extracted bodily from a paper in the *Agricultural Journal of India*,[2] and is here reprinted for reasons set forth in another part of this number of the Journal.

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[1] Studies in Indian Sugar Canes, No 3. The classification of Indian Canes with special reference to the Saretha and Sunnabile groups. C. A Barber. *Memoirs of the Department of Agriculture in India, Botanical Series*, Vol. IX, No. 4, May, 1918.

[2] The classification of indigenous Indian Canes. C. A. Barber. *Agricultural Journal of India*, Vol. XI, Part IV, October, 1916.

The Classification of Indian Canes.

The following is the preliminary classification of the varieties on the cane-breeding station, with the sources from which they have been obtained:—

(1) *Mungo* group.

Mungo, Sabour.
Paunri, Sabour.
Hemja, Bhikanpore, Sabour.
Buxaria, Sabour.
Burli, Ottur.
Kuswar, Ottur, Partabgarh, Aligarh.
Lewari, Sabour.
Poraya, Sabour.
Matna, Aligarh, Shahjahanpur.
Matna Ukh, Cawnpore.
Rheora, Sabour.
Reori, Partabgarh.
Khatuia, Aligarh.
Agoule 1, Shahjahanpur.
Katara, Barah, Partabgarh.
Ramgol, Partabgarh.
Sarauti, Partabgarh.
Pararia, Aligarh, Shahjahanpur.
Matanvar, Partabgarh.
White Pararia, Shahjahanpur.
Dark Pindaria, Shahjahanpur.
Kharwi, Shahjahanpur.
Patarki Mungo (Partabgarh), Gurdaspur.
Matki Mungo, Ottur.

(2) *Saretha* group.

Katha, Gurdaspur.
Lalri, Panipet.
Kansar, Gurdaspur.
Chin, Partabgarh, Aligarh.
Chunnee, Shahjahanpur,
Mesangen, Jullundur.
Saretha, Partabgarh, Jubbulpore.
Dhaur Saretha, Aligarh.
Chynia, Barah.
Baraukha Ukh, Cawnpore.
Jaganathia, Barah.
Ganda Cheni, Mysore.
Khari, Sabour, Jubbulpore.
Hullu Kabbu, Hagari (Bellary District).
Raksi, Shahjahanpur.
Burra Chunnee, Shahjahanpur.
Ramui. Shahjahanpur.

(3) *Sunnabile* group.

Dhaula of Gurdaspur, Gurdaspur.
Teru, Gurdaspur, Harchowal.
Ekar, Jullundur.
Dhor, Jubbulpore.
Hotte Cheni, Mysore.
Rakhra, Partabgarh, Shahjahanpur.
Kaghze, Aligarh.
Sunnabile (Bombay), Jubbulpore.
Khadya, Manjri.
Bansi (Bombay), Nagpur.
Putli Khajee (Assam ?), Ottur.
Bansa, Sabour.
Ketari, Sabour.
Mojorah, Assam.
Naanal, Tanjore.

(4) *Pansahi* group.

Ketari, Sabour.
Merthi, Aligarh.
Dikchan, Partabgarh.
Sanachi (Dumraon), Gurdaspur.
Yuba (Natal), Pusa.
Chynia, Sabour.
Kahu, Gurdaspur.
Lata, Sabour.
Maneria, Sabour.
Pansahi, Sabour.
Sada Khajee (Assam ?), Ottur.
Bharanga, Shahjahanpur.

(5) *Nargori* group.

Nargori, Sabour.
Kewali. Sabour.
Baraukha, Sabour, Pursa, Shahjahanpur.
Ketari, Sabour.
Chynia, Sabour.
Sararoo, Jubbulpore.
Manga, Shahjahanpur.
Agoule 2, Shahjahanpur.
Kalari, Nagpur.
Katai, Sindewahi.
Mungo (*sic*), Shahjahanpur.
Newra, Shahjahanpur.

(6) Unclassified at present.

Bodi, Gurdaspur.
Dhaur. Aligarh, Shahjahanpur.
Dhaura of Azimgarh, Gurdaspur.
Dhaulu of Phillaur, Phillaur.
Kinar, Aligarh.
Kanara, Jullundur.
Agol (Pilibhit), Partabgarh.
Khagri, Sabour, Dacca, Rajshahi.
Ikri, Pursa.
Khelia, Sabour.
Barhai (Jubbulpore), Gurdaspur.
Barahi, Jubbulpore.
Barokha, Shahjahanpur.
Shakarchynia, Sabour.
Betakali (Dumraon), Gurdaspur.
Kalkya, Manjri.

Many of these varieties have at present been insufficiently studied, being only recently received. There are certain obvious resemblances among the unclassified canes, which may be of use in the framing of new classes or obtaining connecting links between those already instituted. Thus there is little doubt that *Ikri*, *Khelia*, and *Khagri* are closely connected, while *Bodi*, *Betakali*, and *Dhaulu* of *Phillaur* seem to be transitional stages between the *Sunnabile* and *Mungo* groups. The position of others is not yet very clearly defined. Thus *Patarki Mungo* resembles *Bodi*, and *Matki Mungo* reminds of *Katha*, although both have been included in the Mungo group, and so on. But, in the main, the classes show true systematic connexion and, in many cases, different names probably refer to the same cane growing in different parts of the country. The localities mentioned do not always indicate the true places where the canes are grown, as most of the varieties have been received from Government farms where collections have been established for the comparison of different forms. Any information which will help to fix the true vernacular names and the exact range of any variety as cultivated will be of special value.

It is to be noted that the lists given above do not include many well-known Indian names. Besides obviously *Pounda* canes, such as *Pundia*, *Shamshara*, *Saharanpuri*, *Poovan*, etc., there are such others as *Kajla*, *Vendamukhi*, *Magh*, *Dahlsunder*, *Yerra*, about which some doubt may exist, and the line is sometimes very hard to draw. But the principle has been adopted of excluding all canes about which there is any doubt, and it is quite possible that further study may cause the introduction of some of the thicker canes into the indigenous series, as has recently been the case with *Mojorah*, *Sada Khajee*, and others. In other words, thickness is not the only determining character, and the present classification can in no sense be considered the last word in the matter.

C. A. B.

It is reported from Prague that Austria has purchased 60,000 metric quintals of sugar from Czechoslovakia. The price per kilogram is 7 Czechoslovak crowns for granulated, and 7·50 Czechoslovak crowns for cubes respectively. A large quantity of Czechoslovak sugar has also just been disposed of in France, where a group of sugar refiners and chocolate manufacturers have purchased 430,000 quintals of granulated sugar.

The *Times* states that last year the Legislative Council of Mauritius voted a credit of Rs. 17,000,000 for the carrying out of extensive public works in the island. These works were to include extensive improvements to the harbour of Port Louis, sanitation improvements in various parts of the colony, the erection of a number of public offices, the building of dwelling houses for the working classes, the purchase of new railway rolling stock, and many other subsidiary works. Up to the present this great programme remains unfulfilled.

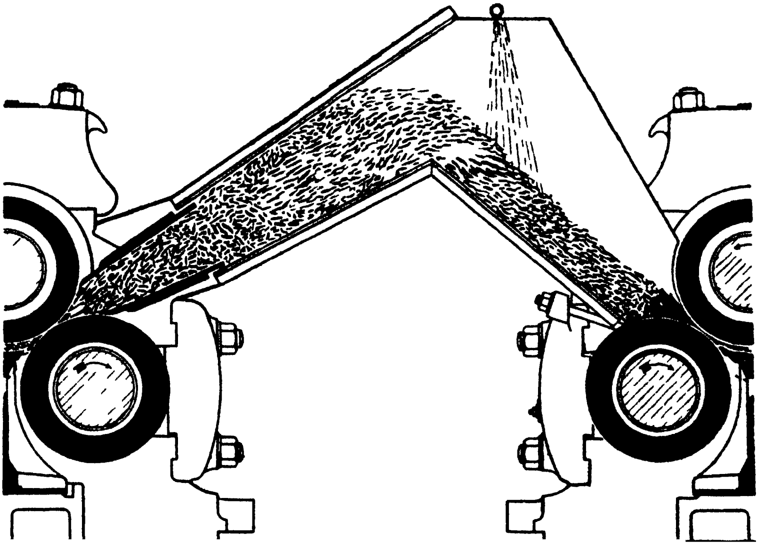
We understand that Messrs. Ransomes, Sims & Jefferies, Ltd., of the Orwell Works, Ipswich, have just been appointed sole manufacturers and licensees in the United Kingdom, the Colonies and Dependencies, South America, Dutch Indies and China, for the Patent Kestner Water Tube Boiler. This boiler has had a great success in France, where the highest economy is a *sine quâ non* in steam generation. It is manufactured in that country by the well-known firm of Schneider & Cie., of Le Creusot, and is in use at many of the large municipal power stations.

We regret to record the death of Mr. J. J. CHERRY, a partner in the firm of H. H. Hancock & Co., the well known Mincing Lane sugar brokers. He had been seriously ill for over a year and earlier hopes which were entertained for his recovery were doomed to disappointment. Mr. CHERRY was an unusually well-informed man, not only in respect to the particular branch of the sugar industry in which he was engaged, but also as regards the producing side, and he displayed a well-balanced judgment of the needs of the industry as a whole. His death comes as a loss to British sugar interests.

Bagasse Conveyors between Mills.

In the late seventies with the introduction of double crushing and maceration, bagasse conveyors between mills became a necessity. Amongst the earliest was Russell & Risien's patent, which consisted of wire frames attached to chains, conveying bagasse from the first to the second mill, through a closed chamber, with hot water dripping on top of the bagasse, and steam ejected through the wire on the underside. This was a dirty, messy arrangement, and the wear and tear on the chains was excessive. Another was the slat conveyor, with wooden or perforated iron slats, attached to endless chains, the maceration water being applied on the bagasse as it left the preceding mill of a train. The foregoing carriers were placed between mills arranged at a considerable distance apart, and each driven by its own engine.

The introduction of a number of mills driven by one engine through a train of gearing necessitated the use of very short carriers, and quite a large number of conductors have been installed,—the most commonly used consisting of narrow overlapping slats bent to a particular shape, carried by two or three chains working over sprockets and receiving the bagasse from the back rollers of one mill and delivering it to the front rollers of the next following mill. There was no head room between the mills; there was a constant drip of water through the slats,



carrying with it a quantity of fine cush-cush which had to be cleaned out with very great difficulty in order to prevent the chains riding on the sprockets; when this occurred there was a jamb, bent slats, and broken chains. To overcome these troubles canvas belt conveyors were used, which were found to be very expensive, owing to the fact that if for any reason the belts did not run perfectly true great damage was done to the belts.

One of the later methods has been to use a close bottomed steel trough from mill to mill, with chains and angle iron scrapers working in it, taking the bagasse from mill to mill. This has not proved entirely satisfactory, owing to the frequent jambing of bagasse, with resultant breakage of scrapers and chains.

In all the types referred to above, the wear and tear of chains has been found to be a very considerable item of expense, and breakages the cause of many stoppages.

The latest and most promising bagasse conveyor is the invention of Mr. JOSEPH MEINECKE, engineer to the Maui Agricultural Company, at Paia, Maui, Hawaiian Islands. This conveyor (*see illustration*) consists of a trough made of steel plates rising from one mill at a suitable angle, and descending to the following mill at a suitable angle. The bagasse leaving the first mill passes between scrapers on the top and back rollers, with or without Ramsay macerating arrangement. Covering this trough there may be a substantially supported cover of steel plates. The bagasse issuing from the top and back rollers between the scraper plates is pushed steadily up the trough, and on reaching the apex falls readily and regularly into the following mill, maceration water being applied to the descending bagasse.

It will be observed that there is an entire absence of moving parts—no chains, no sprockets, no scrapers. There is a regular flow of bagasse; the trough is water-tight; there is no drip; there is easy access to the mills under the conveyor.

This invention does away with the attendants on the carriers, the sweeping up of fine bagasse, drips between mills, and the wear and tear of chains. Sourness between the mills owing to drips is eliminated, and the whole milling installation can be kept very much cleaner and with fewer attendants than heretofore.

The Meinecke conveyor is no untried invention. It has now worked for two campaigns on the 21-roller mill at Paia. So successful was it during its first year that it was adopted at Waialua (Oahu) and also at Wailuku (Maui), Hawaiian Islands. It possesses a simplicity that will appeal, once its merits are better known, to all who are responsible for the running of cane sugar factories.

City and Guilds of London Institute's Examinations.

Notice has been called on several recent occasions to the Examinations in Sugar Manufacture conducted by the City and Guilds of London Institute,[1] the passing of which is regarded as a useful qualification for the young sugar chemist. Intending candidates are now reminded that the next examination will take place on Tuesday, May 2nd, 1922, and that they should make their entries by March 15th, addressing them to the nearest technical school. Any further information is obtainable from the Superintendent, Department of Technology, City and Guilds of London Institute, Exhibition Road, South Kensington, London, S.W. 7.

Regarding the 1921 examinations in sugar manufacture held in April last, a fair number of candidates presented themselves. In both grades (Grades I and the Final), the papers appear to have been well done, the percentages of failures having been exceptionally low in this subject. Mr. SUKUMAR DUTT, of the Royal Technical College, Glasgow, obtained the First Prize in Grade I, a bronze medal; but no prize was awarded in the case of the Final Examination. It is hoped that a greater number of candidates from the United Kingdom, and especially from over-seas, will be forthcoming for the next examination to be held in May, 1922.

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[1] *I.S.J.*, 1920, 439; 1921, 69, 520.

Recent Work in Cane Agriculture.

SOIL SOURNESS—ITS MEANING AND SIGNIFICANCE. *F. Hardy. West Indian Bulletin XIX, pp. 37-85.*

HARDY offers a comprehensive study of the meaning of sourness and the factors involved, which should be of interest to all sugar cane growers. In a short preface he writes:—"The following article has been compiled mainly with the object of presenting, to agricultural officers and students of agronomy and plant ecology in the West Indies, the main facts connected with the modern conception of soil sourness. In it the writer has attempted to explain, in as simple language as possible, the theory of soil acidity, and to review recent articles on the subject that have appeared in the various publications received at the head office of the Imperial Department of Agriculture." Then follow an explanatory introduction and sections on various factors in soil sourness:—true soil acidity, deficiency in calcium compounds, the toxicity of aluminium, iron and manganese, and the absence of adequate aèration. This valuable monograph on one of the most important features of soils in the tropics concludes with a list of papers on the subject, 79 in number.

REPORT ON IMPLEMENTAL TILLAGE AT ST. AUGUSTINE EXPERIMENT STATION, 1919. *Joseph de Vertueil. Bulletin of the Department of Agriculture, Trinidad and Tobago, Vol. XIX, Part 1, 1920.*

IMPLEMENTAL TILLAGE OF CANES. *Note by Director. Ibid. Vol. XIX, Part 3, 1921.*

The experiments detailed in the first paper were conducted by C. J. BARRILLEAUX, formerly of Audubon Park Sugar Experiment Station, Louisiana, and scientific records were kept and written by J. DE VERTEUIL, the Superintendent of Field Experiments in Trinidad. The work consisted of cultivating growing canes, breaking and levelling land to reform beds, and breaking and preparing land for planting canes, and was started in February, 1919. The implements were imported from the United States as follows:—Two No. 82 "E" horse-hoes, one Double Celery Hiller less leaf lifters or double mould board plough, one Louisiana 4-mule breaking plough No. 12 with knife coulter and No. 5 gauge wheel with two extra shears, two Louisiana black land ploughs No. 9 with La Clevis knife coulter and gauge wheels with two extra shears, and three Famous Pony S.B. or 1-mule ploughs with No. 5 gauge wheels and extra shears. A simple harrow of pointed iron teeth let into a strong wooden frame was designed by BARRILLEAUX and made locally. In each test the work of the implements was compared with local hand labour and the cost estimated, allowance being made for depreciation of the implements and extra feed for cattle involved.

The following are some of the results obtained:—(1) Cultivating growing plant canes (9½ acres). Oxen were used. Working one acre in one day took 6·32 labourers and 4·22 oxen at a cost of $2·89 as against $5·28 for purely hand work by 13·20 labourers.

(2) Cultivating ratoons (11 acres). Mules were used. In order to work the implements the trash had first to be hauled into the drains and afterwards re-spread over the land and the drains cleared by hand. The cultivation of one acre took 20·91 labourers and 0·91 mule at a cost of $6·81 as against 24·20 labourers at a cost of $8·58 for hand work.

(3) Ploughing or breaking land and preparing it for planting canes (10 acres). The superiority of mules over oxen was demonstrated for drilling in this experiment. The advantage of implements over purely hand labour with the

drilling done by oxen and mules was 9·52 and 5·76 labourers and a cost of $5·87 and $2·55 respectively.

It is pointed out that these estimates of the advantages of implemental over hand labour must not be considered as final, for better results would probably be obtained with improved selection and training of the animals. Implemental tillage costs less, employs fewer hands of a kind which is easier to obtain, and a larger area can be worked in a given time. In cultivating growing canes the land is not so well cultivated as when forked by hand, but on the other hand the preparation of the land for planting is better done by implements. Again, approximately two thirds of the labour required for implements consists of young boys who would be idle otherwise, and they thus get a useful training. A table concludes this first paper giving details of the work performed, the number of labourers and animals used with each implement, the average acreage worked each day together with the cost of labour, depreciation of implements and extra feed of animals and total cost per acre.

In the second paper, the continuation of the experiment is recorded during 1920, and some of the yields obtained after each method are given.

(4) Cultivation of ratoons (equal areas of 9·29 acres). The cost per acre with implemental tillage was $5·81 against $9·15 for hand labour.

(5) Cultivation of plant canes (equal areas of 9·35 acres). This worked out as $1·87 and $5·67 respectively. Another set of experiments was made to test the yields of the same varieties of cane under the two treatments. The tons of cane per acre are given in seven experiments, and in all but one implemental tillage had the distinct advantage. The average yield per acre in these seven was 33·01 tons of cane for implements against 28·78 tons for hand labour.

ERADICATION OF MOSAIC DISEASE IN TRINIDAD. *Note by W. Nowell Bulletin of the Department of Agriculture, Trinidad and Tobago, Vol. XIX, Part 3, 1921.*

The campaign among the northern small holdings was vigorously continued. The number of farms in the infected district is about 1700, comprising 1250 acres, of which at least 1000 acres have been worked over, eight drivers and 100 labourers being employed. The total number of stools destroyed was 44,000, of which 6000 were young canes. The cost of the work was slightly under the estimate, and would with experience probably be reduced. The weather was unfavourable, in the absence of the expected definite dry season, the showers of March and April offering conditions which might cause infection to be resumed. The work was well in hand and promised a successful issue, the farmers taking the interference in good part and in no case offering serious opposition.

PLANT INSPECTION AND QUARANTINE REPORT, PORTO RICO, 1918-19. *Bulletin No. 23, Department of Agriculture and Labour, Rio Piedras, 1919.*

This bulletin includes two papers dealing with insect pests and fungus diseases respectively, although of very unequal length and importance. The main work of the service has been to keep out insect pests, and in this report, E. G. SMYTH, Chief Entomologist, offers a résumé of the history of the work since its inception in 1910, extracting from each annual report the main points of interest. Full tables are added of the plants, fruits, seeds and insects intercepted each year. The service, like others in Porto Rico, has suffered very considerably from the constant changes in direction and of actual workers, and these are methodically set forth. In spite of this very heavy handicap, a perusal of the tables shows that important work has been done, in all directions, towards the prevention of insects likely to be injurious to the staple crops of the island. Of the latter, the two receiving most attention have been fruit (especially citrus) and sugar cane, and it is noted that these crops have received a very different amount of assistance in quarantine regulations from the Federal authorities. The matter is somewhat complicated, but the reason for refusing to aid the sugar cane work appears to lie in the settled policy of the Federal Horticultural Board to interfere as little as possible with local efforts, and to leave alone staples not of general interest to a considerable number of States. That California received special protection for its fruit industry is reasonable, in that it embraces half of the Pacific coast, and some measure of this protection has been extended to Porto Rico.

Among many interesting cases commented upon by the author two may be here mentioned. The first is the treatment of the ship loads of sugar cane brought over from San Domingo to be ground at Guanica Central. By the insular quarantine laws, plant products intended for manufacture or grinding are not subject to restrictions as to entry, but such may be put upon them by the Director of Agriculture and Labour. It was soon found that fumigation of these canes was necessary because of the presence in San Domingo of serious cane pests not in Porto Rico, and it was arranged that this fumigation should take place while the steamers were en route, and sometimes loads were held up on entry because it had not been properly done. By a study of the dead insects in the holds of the steamers important information was sometimes obtained as to San Domingo pests, some of their natural enemies being found there which had never been observed in the cane fields. The importation of grain in bulk was another difficulty, since food products were also unrestricted. But the Chief of the Food and Drugs Inspection Laboratory had power to veto the introduction of adulterants. To inspect and disinfect the whole of the grain cargoes was far beyond the strength of the quarantine service, but power was obtained through the co-operation of the chemical authorities to deal with the extreme cases and thus to prevent the importers of grain from "spreading loads of vermin broadcast over the island." The commoner pests of stored grain were already well known in Porto Rico, but there was no sense in constantly drenching the country with them in fresh numbers. The interesting summary of each year's work, hitherto carried out by the entomologists of the Insular Experiment Station, should prove a valuable addition to the literature of plant quarantine

The second paper in the bulletin is very short, and signed by J. MATZ, the chief pathologist. The quarantine of plants suffering from fungus diseases is a very much more difficult thing to the keeping out of injurious insects, and it is pointed out that many plants at entry may show no signs of being the harbourers of infectious diseases. The remedy suggested is an indirect one, and consists in a thorough study of the diseases prevalent in other countries likely to be sending plants to Porto Rico. A short list is appended of the chief crops and their main diseases, some of which have not yet been met with in the island. Those under sugar cane are Fiji disease, *iliau*, smut, gumming, rust and *sereh*.

PLANT INSPECTION AND QUARANTINE REPORT, PORTO RICO, 1919-20. *Bulletin No. 27, Department of Agriculture and Labour, Rio Piedras, 1921.*

This bulletin opens with a further change in the venue of the service. "This service was, until last year, in charge of the Division of Entomology of the Insular Experiment Station at Rio Piedras. The arrangement worked injury to both station work and the inspection service. Consequently recommendations were made for the separation of the plant inspection and quarantine service from the Division of Entomology. In attention thereof the position of plant quarantine inspector for the port of San Juan was created by the Insular Legislature, and filled by the Commissioner of Agriculture on September 1st, 1919." At the same time a Technical Board, composed of the Director of the Insular Experiment Station, the Chiefs of the Entomological and Plant Pathology divisions, and the Expert in Cane Diseases, was formed, with the Plant Quarantine Inspector as secretary. This has the appearance of a useful measure as regards the economical employment of the experts.

The files and records were organized, and many papers were translated from English into Spanish for wider circulation. A daily report was started of work done at the post office, customs house and express, and more complete monthly reports issued. A case of unlawful entry of 4000 lbs. of cotton seed engaged a good deal of attention. Most of the seed was recovered and carefully scrutinized. In it were found dead boll weevils and three actually living, and the plants growing from the seed were very carefully and repeatedly examined, without finding any trace of the pest. But this examination brought to light the fact that leaf blister mite of cotton was present in Porto Rico. And the important question arose as to whether the island would be quarantined by the United States, a proceeding which would be a great blow to the rising cotton industry. Considering that no cotton seed is sent to the mainland, and all the lint is sent direct to New York where it is immediately fumigated with hydrocyanic acid gas, no action has been at present taken in the matter.

Tables form as usual the chief part of the report. The first gives the details of the inspections at the ports of San Juan, Ponce, Mayagüez and Ensenada; the second, of the insect pests and diseases interceped; and the third, the total numbers of bundles destroyed, accepted, fumigated, quarantined and returned, classified according to plants and seeds, ornamentals, fruits and fruit trees, sugar cane, vegetables, and miscellaneous.

THE BROWN HARD-BACK GRUB IN ANTIGUA. *H. A. Ballou. West Indian Bulletin, Vol. XIX, No. 1, 1921.*

This pest was apparently unknown before 1911, and has always been more severe in its attacks on onions, maize, sweet potatoes and yams than on sugar cane, but as in the opinion of planters it was fast becoming a major sugar cane pest the author has given it as careful an investigation as time permitted. Root disease of the sugar cane is well known to the planters in Antigua, but there appears to be an increasing tendency to put down the "root disease condition" of the clumps, with stunted, unhealthy, and rotten canes in which many of the shoots were dead, to the hard-back grubs. There were, however, strange anomalies in their incidence. In some cases diseased plants had numbers of grubs underneath them, but at the same time other obvious influences were present which of themselves would be quite capable of inducing the diseased appearance, while in other cases surprising numbers of grubs were found under perfectly healthy plants. This is not to be wondered at when we remember that the grubs are humus feeders and will at all times prefer a diet of this substance to that of cane roots.

The author points out that the grubs of this class of beetles have received increasing attention during recent years, and refers to the epidemics in Barbados, Mauritius, St. Kitts, Porto Rico, the United States, Canada and Australia. While in some of these places the attacks are connected with definite symptoms in the growing canes, no such characteristic appearances have been met with in Antigua. The knowledge thus far obtained regarding the habits of the hard-back in Antigua is contained in certain observations by TEMPANY, ELDRIDGE and the author and, although other important work prevented a full study being made, these sources have been fully utilized in the preparation of the present paper.

ELDRIDGE commenced weekly notes on certain infested fields in 1919, selecting three fields on a certain estate, plant canes and first and second ratoons, and at each visit he dug out 2ft. square holes in a bank, in a bar, and under an unhealthy plant in the vicinity. All grubs and beetles found were collected and classified. In the field of plant canes 25 visits were paid and 264 grubs collected, 56 per cent. of which were found under the canes lifted; in the first ratoon field 734 grubs were obtained during 26 visits, with 58 per cent. in the cane holes; while in the second ratoons 27 visits procured 849 grubs of which 65 per cent. were found under the canes dug out. Generally speaking, the number of grubs found was considered insufficient to be the sole cause of the unhealthy appearance.

BALLOU'S own investigations, made in conjunction with ELDRIDGE, in January to March, 1920, cover 120 cane clumps and extended over a much wider area, although including the fields mentioned above. In each observation a whole clump of canes was dug out, with a 4½ ft. × 4½ ft. hole, as deep as any grubs were met with, and the clumps were of all kinds, diseased, merely unhealthy, and healthy, under the most varying conditions as regards soil and surroundings, the opinion of the manager of the estate being recorded as to the general condition of each field. A number of these observations are described, and the general impression after reading this part of the paper is that there were as many grubs to be found under healthy as diseased cane clumps, and that there was no preference shown by the grubs for any particular kind of soil or other circumstance. The author states that, in Mauritius, there is a law that, when the number of grubs in a field is judged to be 20,000 to the acre, that field must be dug up and the grubs collected and destroyed. These figures are often largely exceeded in Antigua without apparent harm. In one field the numbers calculated from ten unhealthy clumps was 65,000 to the acre, while in six healthy clumps in the same field it was 66,000. In another field the numbers were estimated as 104,000 and 69,000 respectively.

Taking these observations into consideration, BALLOU concludes, after surveying the current agricultural practice of the estates, that the system of forcing the land to produce crops of cane with little or no rest between is much more likely to bring about the "root disease condition" than the Lachnosterna grubs, although the latter, if present in excess, may well be a contributory cause. This appears to be a not unreasonable assumption when, as he reminds us, we remember that the grubs appear to prefer humus if they can get it to the cane roots. He recommends better and more frequent tillage, better preparation for plant canes with more frequent applications of coarse organic manures which can only then be given, proper drainage of the land, and the introduction of a proper rotation crop at frequent intervals; lastly, if the grubs become very numerous, the planting of a trap crop, such as maize. Certain striking cases are cited of rapid improvement of typical root disease fields when such measures have been adopted, both in Antigua and St. Kitts.

The paper concludes with a collection of observations of a scientific nature drawn from the materials collected, although the full life history of the pest has not yet been worked out because of more pressing duties elsewhere. It appears that there are no less than 35 species of Lachnosterna in the West Indies, many of which, no doubt, are of economic importance. That in Antigua has been named *L. Antiguæ.*

C. A. B.

Manufacture of White Sugar, using Ozonized Air.

A good deal of work has been carried out with the object of utilizing the powerful oxidizing effect of ozone for the decolorization of sugar factory and refinery products. Opinion on the processes evolved by the numerous inventors, such as HAGEN,[1] DESPEISIS,[2] FAHRIG,[3] THE ELECTRIC RECTIFYING AND REFINING CO.,[4] BEANES,[5] JOHNSON,[6] SCHOLLMEYER,[7] VERLEY,[8] STEFFENS[9] and LUNDGREN & GIERLING,[10] is at the present time generally that their great disadvantage is the enormous power necessary for the generation of the ozone.

Dr. C. W. SCHONEBAUM chose "The Ozonizing of the Products of the Sugar Industry" as the subject of his thesis for his doctorate degree at the Technical High-School at Delft, Holland. This thesis he has published,[11] and one must admit that it is a highly interesting study, which enables one to view the problem in a more favourable light. Instead of treating the whole of the juice as inventors have usually proposed to do, he suggests that after taking off a first crop of crystals and washing to white sugar, the run-off syrup should be ozonized, in order to produce a syrup from which a second white sugar may be boiled. A few notes from Dr. Schonebaum's booklet are here extracted, but his publication should be studied in detail by those who are particularly interested in the subject. Under conditions in which fuel or electric power is comparatively cheap, it would seem that the method of working proposed is worthy of serious consideration.

APPARATUS EMPLOYED.

A Siemens-Halske ozonizer, type Oz 5, with 5 elements worked satisfactorily throughout all the experiments for the production of the ozonized air, the current from the main at 220 volts being transformed to 8000 volts. About 75 watts for the battery of five elements were found necessary. Before it entered the ozonizer, the air was purified by passing it through washbottles containing concentrated sodium hydroxide and sulphuric acid, then through towers filled with soda-lime and calcium chloride. In order to obtain the maximum yield of ozone, the air should not contain more than 4 grms. of water per cu. m. Lastly, the ozonized air leaving the fifth element was conducted through a glass tube into flasks, in which the ozonizing of the sugar product was effected.

SUMMARY OF RESULTS OBTAINED.

The literature of the subject being rather inconclusive regarding the action of ozone on solutions of the pure sugars under various conditions, the author set himself to answer a number of questions, the replies to which are here summarized.

In alkaline solution, sucrose, dextrose and levulose are decomposed as the result of the lengthy action of ozone; in acid solution they are resistant (apart naturally from the hydrolysis of the sucrose); and in neutral solution sucrose is unaffected at ordinary temperatures, though it is inverted at higher ones. Dextrose and levulose are not attacked in neutral solution, even when the solutions containing them are heated. As the result of the decomposition of the three sugars by ozone, formic and carbonic acids are formed, the former being finally broken down to the latter.

For the decolorization of sugar juices, syrups, etc., only a short ozonization is necessary, during which short time no sugar is decomposed in the case of slightly alkaline or neutral pure solutions. Coloured products of the sugar industry are rapidly decolorized by ozonization. Decolorization is more rapid at high temperatures (say 70–80°C.) than at low ones. All the intermediate products of the sugar industry can be decolorized by ozone, the concentration of the liquor having no influence on the degree of decolorization.

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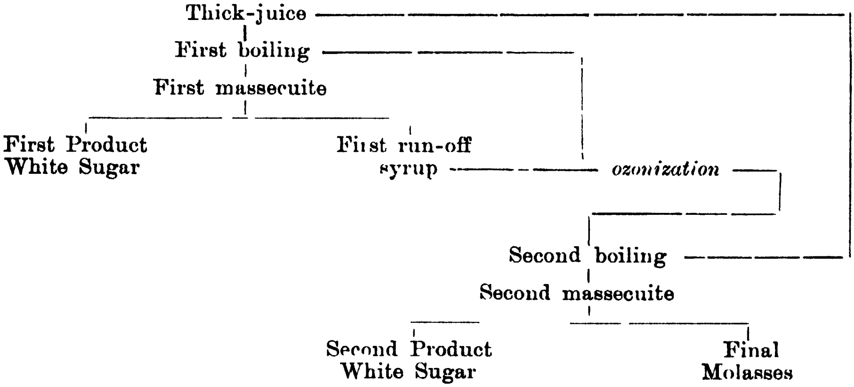
[1] German Patent, 18,723 of 1881. [2] English Patent, 4148 of 1883. [3] English Patent, 3556 of 1886.
[4] French Patent, 262,214 of 1896. [5] English Patent, 11,511 of 1898. [6] English Patent, 1131 of 1898.
[7] German Patent, 109,589 of 1899. [8] Austrian Patent, 47/5128 of 1897.
[9] French Patent, 385,639 of 1908. [10] U.S. Patent, 1,063,708 of 1913.

[11] "Ozoniseeren van Fabrieksproducten der Suikerindustrie"; published by the Author at the School voor Suikerindustrie, Heerengracht 567, Amsterdam.

In addition to effecting decolorization, ozonization removes the unpleasant smell, and also improves the taste in the case of beet products. No considerable rise in purity could be observed. Pectin substances are eliminated by ozonization, as was clearly seen with the tropical molasses; and one obtained the impression in these laboratory tests that the filtration of syrups and molasses is facilitated as the result of ozonizing. It was found that for the elimination of a certain quantity of the same colour, a definite quantity of ozone is necessary; in other words, the effect is independent of the amount of ozone in the air used, and also of the concentration of the juice or syrup.

CALCULATION OF THE COST OF WORKING.

A good first product white sugar can be obtained in the beet sugar factory without the use of any purifying agents other than lime, carbon dioxide, and sulphur dioxide; but the run-off syrup from this first massecuite is "just not good enough" for the purpose of boiling a second crop of white sugar when using a *pied de cuite* of thick juice. Therefore, the after-product obtained must be remelted, and the liquor treated again, before it can be boiled to a white sugar. It is suggested that at this point ozone should be applied. For example, in the following scheme:—



It is difficult to state the amount of run-off syrup obtainable, but it will be assumed that per 100 kg. of roots this is 12 kg. of 80° Brix. Experiments show that about 200 mgrms. of ozone are necessary in order to decolorize 100 grms. of this syrup to the same degree of colour as the thick juice,[1] or 24 grms. of ozone per 100 kg. of roots. Ozone installations are on the market with a production of 12 kg. ozone per hour, or 288 kg. in 24 hours, which quantity should thus be sufficient for a factory slicing 1,200,000 kg. in 24 hours.

It was calculated that the operating costs for an installation having a capacity of 12 kg. of ozone per hour would work out as follows in Dutch florins:—

Power consumption	F0·65
Salaries and wages	0·50
Spares	0·08
Interest and depreciation	1·92
Cost per kg. of ozone	F3·15

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[1] It is mentioned that filtration is necessary after ozonization.

These figures are applied to the production of a sack of raw sugar (containing 100 kg.), obtainable from 250 kg. of syrup, for the sufficient decolorization of which 0·5 kg. of ozone is necessary. Therefore, per sack of second product white sugar the costs of ozonizing are: 0·5 × F3·15 = F1·575, or in round figures, F1·60. This figure of F1·60 should be compared with the cost of refining low quality raw sugar (by "Norit" or other means). The difference between the two figures will not be great; but the molasses obtained is of much better quality in respect of smell and taste.

Assuming that these results obtained in the laboratory hold also for large scale conditions, it may be concluded that the purification of syrups by means of ozone should not be rejected as being too costly without further examination. In order to establish the exact quantity of ozone necessary, tests should be carried out with a small technical apparatus capable of giving 100 grms. of ozone per hour. In this way, one could decolorize a considerable quantity of syrup, so that it would be possible to produce an experimental strike. The cost of the installation mentioned should amount to about F10,000, and the favourable results obtained in the laboratory experiments surely justify the risking of this sum.

Discussions of Recent Reports on Milling of the Hawaiian Chemists Association.

The Hawaiian Chemists' Association has now published the discussions taking place after the reading of the interesting reports on the progress of milling in the Territory,[1] an abstract of which discussions here follows:—

CARRIERS.

Mr. R. E. **HUGHES** said that the independent drive is preferred, being a more flexible arrangement than coupling up with the mill. At Puunene the carrier is driven by a 2-cylinder Sturtevant engine, mounted on a platform directly under the chute to the crushers, the mill feeder controlling the engine from the platform above. The drive from engine to carrier shaft is made up of steel sprockets and finished steel roller chain through two countershafts to allow for suitable reductions, an arrangement which has worked very satisfactorily. The carrier chain is of the SS 96 Link-Belt type, 6 in. pitch, made up with a 2¾ in. bushed steel roller on every pin, these rollers running on a railroad track bolted to the carrier frame with angle-iron guide bars to prevent the chain moving sideways.

REVOLVING KNIVES.

Regarding the power required to drive the Meinecke knives at Paia, Mr. J. P. **FOSTER** said that when set ⅝ in. from the carrier slats these were first driven by a 75 h.p. motor, which later was found to be overloaded, so one of 150 h.p. was installed. Tests show that 50–125 h.p. for 66 knives is required. Mr. J. L. **RENTON** said that at Ewa there was a set of 68 Meinecke knives cutting 65-80 tons cane per hour with a 100 h.p. motor, averaging 60 amps., but often higher.

CRUSHERS.

Mr. J. N. S. **WILLIAMS** said that the Cutler-Hammer type of magnetic separator for the removal of iron tools and such like from the cane entering the mills is probably the most practical and efficient device yet put on the market.

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[1] *I.S.J.*, 1921, 90.

SHREDDERS.

Replying to a question regarding the numbers of bars used in the shredder at different places, Mr. HUGHES stated that at Puunene three sets of grates were used during the last season. During the last month of grinding, he had tried one shredder with only two sets of grates, finding no difference in the quality of the work. Two sets only will be used next season in each machine, and it is expected that less power will be required. At present the shredders are driven by a 300 h.p. motor, and at 60 tons of cane per hour and over the power required is about 150 h.p. But the power consumption does not increase anywhere in proportion to the increased rate of grinding.

INTERMEDIATE CONVEYORS.

Replying to questions, Mr. J. P. FOSTER said that the Meinecke chute is not placed at any specific angle. It is a guide plate only. There seems to be no reason why wet macerated bagasse should not be sent up the chute. The time needed to clean the Meinecke chute is insignificant compared with that demanded for the repair of breakages in the case of other apparatus. Last season there was not a moment's delay at Paia due to them.

MACERATION.

Dr. NORRIS, in some recent tests on the efficiency of maceration, has found that when the conveyor between the fourth and fifth mill is stopped for 10 mins. or so, the ratio of admixture was considerably higher than when running normally, showing the considerable importance of the time element. Commenting on these results, Mr. W. R. McALLEP remarked that the mixture of the maceration water with the juice remaining in the cane is far from perfect; and there are few mills in which efficient crushing is done where dry streaks cannot be found in the feed. Improvement of the efficiency of maceration is the most promising field of investigation for increasing the efficiency of the milling work. Mr. H. S. WALKER remarked that the fourth roller is a logical device for effecting the more complete admixture of maceration water with the residual juice in the bagasse, and tests made at the Pioneer mill several years ago showed a decided gain due to the fourth roller, which was given up because it would not work with the Ramsay scraper.

Mr. J. N. S. WILLIAMS, in respect to floating rollers for the purpose of compressing bagasse issuing from one mill to effect a better distribution of the maceration water, said that their trial was due to experiments made by Mr. HAMILTON McCUBBIN at the Pioneer mill where they worked smoothly and produced good results. When applied to the first two mills in a 9-roller train, 25 per cent. of water would produce as good a saturation with the roller as 40 per cent. without it. However, it was found that when using this fourth roller that it was impossible to install the Ewart conveyor, and also difficult to keep the Messchaert grooves in the back roll free. There is no question that this device is of decided benefit, but it has marked drawbacks.

In order to improve the distribution of the maceration water, water at boiling point has been tried in a Hawaiian mill, but had to be discontinued owing to its injurious effect and the greater amount of fine trash. Steam, however, appeared to penetrate where water might not reach, and give a blanket in which no dry place could be detected.

JUICE STRAINERS.

Mr. S. S. PECK pointed out that there are several advantages to be gained by abandoning the present type of strainer with drags. One is that woven wire screen can be used instead of perforated metal, giving a larger straining area with the same size of opening, or a smaller opening with the same straining area, depending on the gauge of the wire.

15-ROLLER MILLS.

Mr. H. S. WALKER mentioned that another 3 rolls had been added at Pioneer, making a 15-roller mill; also a new shredder and crusher, while all the feed rollers were deep-grooved. As the result, the extraction was increased 0·67 per cent., and the average grinding speed 9 per cent., the purity of the last mill juice dropping from 67·54 to 65·71. By the *sjm* formula, about 75 per cent. of this increased extraction would be available. But probably owing to the finer shredding and heavier grinding, a great deal more work was thrown on the filter-presses, so that the press cake per 100 of cane had risen from 2·75 in 1919 to 3·51 in 1920, an increase of 27·5 per cent.

Mr. J. H. PRATT stated that at Puunene when operating as a 15-roller mill an extraction as high as 99·57 was obtained for one day when grinding cane of only 8 per cent. fibre, and running very slowly. As high as 99·4 per cent. resulted with cane with 11·5 per cent. of fibre. In 1916 he made a chart to show the influence of the fibre on the extraction, including the results of as many seasons as possible to eliminate the effect of other factors. The points plotted showed the curve to be practically a straight line; and the angle of the curve using the shredder to be about one-half that without the shredder, showing that the shredder reduced the influence of the fibre on the extraction about one-half.

Mr. R. E. HUGHES mentioned that during two weeks of the crop at Puunene he ran 12-roller mills getting 99 per cent. extraction. No change in the settings is made with a 15 as compared with a 12-roller mill, the greater the number of mills in train the less the influence of the fibre.

Mr. J. P. FOSTER stated that Paia has a 21-roller mill giving an average extraction of 99·05 per cent. for the crop and 99·37 as the highest weekly average. He added that the amount of fibre has less influence than its nature, that of H 109, for example, being more troublesome than that of Lahaina, the amounts being the same in both cases.

Mr. SCHOLEFIELD endorsed the last statement. Canes grown on the windward side of an island are more difficult of treatment than those on the leeward side, the fibre content being the same in both cases. Exposure toughens the fibre.

Mr. HUGHES remarked that a shredder is a leveller of different fibres, decreasing the influence of the fibre on the extraction. D 1135 and H 109 do not shred up so finely as Lahaina, due to the amount of rind fibre.

Mr. J. N. S. WILLIAMS recalled that years ago at the H. C. & S. Co.'s factory at Puunene with a 9-roller mill they found a material difference in the extraction from cane which was dry and drought-smitten with a fibre content between 14-15 per cent., and ordinary well-nurtured cane with a fibre 9-12 per cent. Ordinary cane constantly gave an extraction of 93·5-94·5; whereas with the cane that came over from Kihei grown under arduous conditions of climatic and water supply, and consequently containing a high fibre content, the extraction dropped to 92-92·5 per cent. with the same speed and the same settings. It stands to reason that it must be so. With 15 per cent. fibre there will be 300 lbs. of dry fibre per ton of cane and with 10 per cent. only 200 lbs.; so that assuming the amount of sugar per unit of fibre to be the same in both cases, then the sugar carried off by the bagasse from the high fibre cane would be 50 per cent. greater than in the other case.

Manufacture of Rum from Beet Juice.[1]

By Prof. HUGO HAUPT.

After efforts extending over 12 years the firm of HÜNLICH, has succeeded in preparing "German Rum" by the fermentation of beet juice, raw beet sugar, beet molasses, etc. From a study of the whole mode of manufacturing rum in tropical countries, it results that it is not the nature of the sugar employed, but rather the procedure that plays the decisive rôle in obtaining this product. In spite of lack of success at the first, the trials made in the direction of observing exactly the conditions of fermentation in the tropics, and the proper choice of organisms, have finally resulted in obtaining a product from German raw materials, which, in respect of odour and taste, as well as chemical constants, almost equals genuine rum of average quality. . . .[2]

PRODUCTION OF JAMAICA RUM.

For the formation of the aroma in the wash and in the finished rum respectively the rational treatment of the dunder appears to be of particular importance. The heavy volatile acids of high molecular weight are probably retained in part in the spent wash during the first distillation. It would only be by a new fermentation that an etherification and a formation of aldehyde would take place under the influence of certain organisms in the medium of these residues rich in albuminoid matter. Then, according to the Jamaica manufacturers, the use, not of modern columns, but of ordinary stills, is of great importance in the production of rum.

The manufacture of rum in other countries, as Cuba, British Guiana, Martinique, and Brazil, differs notably from the procedure described above.[3] Especially, additions of aromatic and tannic substances are made, such as the bark of some kinds of acacias, *Aeona squamosa* flowers, peach leaves, which are introduced into the still. . . . .

PRODUCTION OF "GERMAN RUM."

The process instituted by FRITZ HÜNLICH closely resembles that in use in the West Indies. Fermentation takes place in premises where the temperature is maintained at the high degree prevailing in the tropics, under the influence of specific ferments, the work being carried out in stages. Beet molasses is set up separately; and, using spent wash remaining after the distillation of fermented wash, a dunder is prepared by the addition of sugar, nitrogenous residues, and fruits. In order to do this, the mixture is submitted to a bacterial fermentation at high temperature.

In addition to aromatic substances, some undesirable bodies are formed, the elimination of which is effected by a special process. The dunder having been made, it is then introduced in a determined proportion into the fermenting molasses wash before the distillation. It is clear that the nature of the fermentation organisms play a great rôle in the development of the aroma of the rum. Efforts have been made to select the yeasts by pure culture, and to inoculate them, as BECKER succeeded in doing in German West Africa, where he produced a good rum by the aid of yeast imported from Cuba. It is not the nature of the raw material, whether from the cane or the beet, that plays the decisive rôle from the point of view of the character of the rum, but the nature of the fermentation organisms, and the exact adaptation of the mode of working to their most favourable conditions of existence, such as the acidity of the wash, the aeration, and the temperation of fermentation. . . . . According to STADLINGER, the addition of well prepared dunder assures a good nutritive ground for the colonization of acetic and butyric bacteria, giving conditions much more favourable to the growth of the yeast in molasses wash than in neutral solutions of sugar. Further, the formation of ethers in the wash, upon which particularly the special odour and taste of rum depend, is thus promoted.

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[1] Abridged translation from the *Chemiker Zeitung*, 1921, 45, No. 116, 929.

[2] Here follows a description of the method of manufacturing rum in Jamaica, taken presumably from that given by JAS. C. NOLAN in the "Report of the Royal Commission on Whiskey and other Potable Spirits."

[3] For further information on the subject of rums see: F. SELL, *Arb. Kais. Gesundheitsamt*, 1891, 7, 210; K. WINDSCH, *Ibid.*, 1893, 8, 278; KOENIG, *Chemie der menschl. Nährungs-u.-Genussmittel*, 1, 1410; 2, 1332; JONSCHER, POLENSKE, MICKO, MANSFELD, and others have also done work on the subject.

Distillation is effected, in general, by the use of modern apparatus, the first product being an alcohol particularly rich in ethers. The alcohol following, which contains only small quantities of ether, is mixed with the first product (called high wines), whence result different qualities of commercial "German rum."

COMPARISON BETWEEN TROPICAL AND GERMAN RUMS.

The character of rum as a fine spirit is conditioned by the aromatic substances peculiar to it, substances which vary notably with the quality and strength of the different commercial grades, but which have a common characteristic, as with other pure products of fermentation, wine or beer, for example. For the appreciation of the value of rum, the content in ethers and acids, that is to say its chemical composition, does not suffice; the odour and the flavour, and the delicacy of the aroma all play an essential rôle, as with the other fine spirits.

Tests were made concerning the odour and flavour of three different marks of "German rum" compared with genuine commercial Jamaica rums (the authenticity of which was established by chemical analysis), taken from bonded warehouses, in which they had been placed by importers of the first rank. They were carried out as follows: The samples were brought to the same alcohol content with soft water, and numbered; they were then submitted to the appreciation of various persons, among whom were several professional tasters. Further, using warm water and sugar, grogs were prepared, which were also tasted.

The results were as follows:—Almost all the persons participating in the experiments considered that the "German rum" was fully equivalent to the Jamaica rum of average quality. One person only, whose sense of smell was apparently particularly delicate, observed an aroma different in several respects from that of genuine rum, recalling the production of substances originating from the beet. All the observers were unanimous in declaring that the Jamaica rum of inferior quality, such as is now imported in greater quantity than before the war, owing to the economic situation, is much below the "German rum" in respect of delicacy of aroma and pleasantness of taste. Jamaica rum of first quality was found to possess a finer and more abundant aroma than the "German rum"; but that of average quality was considered to be equal to the "German rum."

CHEMICAL EXAMINATION.

Regarding the chemical examination of the rums, the method of operating the qualitative tests was fractional distillation, as indicated by MICKO, and the determination of the content in secondary products of fermentation, as expressed by Lusson-Girard's formula for the "coefficients of impurity." As this latter varies within wide limits, even for tropical rums of the same country of origin, one should not set too much store by its value. Nevertheless, taken with the tasting tests, this coefficient gave good results. It also revealed almost all the falsifications produced by the addition to rum of artificial flavouring substances.

In the preliminary test with sulphuric acid (10 c.c. of rum *plus* 4 c.c. of sulphuric acid of 1·84 sp. gr.) the "German rum" still liberated at the end of 12 hours its characteristic aromatic substances, just as the genuine Jamaica rums were observed to do, being thus differentiated from the artificial rums. But the aroma at the end of 24 hours was not as strong as with the genuine samples with which they were compared.

Considerable fluctuations of the coefficient of secondary products in authentic Jamaica rums have resulted from the analyses of different workers, notably those which have been recorded in the English official statistics.[1] Nevertheless, comparison of a "German rum" with a Jamaica rum certified as being absolutely genuine, and with another Jamaica rum also designated as "genuine," will not be without value:—

	"German Rum."	Jamaica Rum of undoubted authenticity.	Jamaica Rum of Commerce.
Aroma	Analogous to genuine rum	Rather penetrating	Penetrating and disagreeable
Specific gravity of the rum at 16°C.	0·9214	0·8886	0 8753
,, ,, ,, distillate at 15°C.	0·9213	0·8884	0·8751
Alcohol, per cent., by weight	48·97	63·3	69·0
,, ,, volume	56·6	70·8	76·9
Extract, direct determination, in grms.	0·11	—	0·36
Micko's test in the sixth fraction	Slight odour of Russian leather	Strong odour of Russian leather	Strong odour of Russian leather

Further analyses in mgrms. per 100 c.c. of absolute alcohol are as follows:—

	"German Rum."	Jamaica Rum of undoubted authenticity.	Jamaica Rum of Commerce.
Total acidity (calculated as acetic)	114·4	116·0	79·3
Ethers (calculated as ethyl acetate)	355·1	489·4	153·9
Aldehydes (calculated as acetaldehyde)	6·2	15·4	10·0
Furfural	0·7	1·0	1·2
Fusel oil (calculated to isobutylic alcohol)	57·4	135·5	98·6
Lusson-Girard's figure, in mgrms.	533·8	757·3	343·0

These comparisons show that "German rum" closely resembles the tropical product in respect of content in accessory substances. It equals tropical rum of average quality entirely in its content of volatile acids of high molecular weight, and in ethers; and surpasses the imported rum of ordinary quality, as well by its composition as by its delicacy of aroma.

Different researches on "German rum," as well as the repeated examination of the preparation of the rum by the manufacturer, have led the author of this paper to the belief that the new product possesses the right to the name of rum. According to present definitions,[2] rum is a potable spirit obtained where the cane is grown, consisting in the fermentation and the distillation of the juice, molasses, scums, and other residues of the sugar cane.

There should be no reason for refusing to the product of fermentation described in this paper the designation of "German rum," especially as this term would indicate its origin sufficiently without further explanation.

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[1] "Minutes of Evidence taken by the Royal Commission on Whiskey and other potable Spirits"; Vol. II, page 217 (Analyses of Jamaica Rums from the Docks, handed in by Mr. F. L. TEED, F.I.C.).

[2] See *Zeitsch. Unters. Nährungs-u.-Genussmittel*, 1905, **24**, 145.

Noël Deerr's "Cane Sugar.'

III.

CHEMICAL SECTION.

If Deerr's new edition of "Cane Sugar" can be pronounced valuable by the agriculturist and engineer, as the two previous reviews have indicated,[2] this opinion can certainly also be endorsed by the chemist. It contains a wealth of information on processes of cane sugar manufacture, on analysis, and on control, making the volume an indispensable one to all sugar factory chemists.

Clarification, of course, is one of the most important matters concerning the chemist. In this new edition, that portion of the book dealing with this subject has been re-cast, and fresh matter of a useful nature now appears. There is a short discussion on the colloids of cane juice, and a summary of the original work carried out by the author himself on the colloidal nature of clarification, an aspect with which the up-to-date chemist should surely be acquainted, so important are its possible bearings at several stages of manufacture. At present our knowledge of the behaviour of the colloids of cane juice is as yet comparatively slight, but when it increases, as it doubtless will do in time, it is hoped that more light will be thrown on the problems involved in the clarification operation itself, in filtration, in boiling, and in the separation of the last possible amount of sugar from the molasses. Among other matters dealt with under this heading are: the nature of inversion; the effect of high temperatures on sugar solutions; the action of alkalis on reducing sugars; and the determination of acidity and alkalinity of raw and clarified juices.

Coming to the more practical points connected with clarification, there are good sections on: the quantity of lime required for tempering; juice heating; and continuous settling. Carbonatation receives fairly complete attention; while sulphitation with its several modifications is very fully treated, and makes a very good chapter indeed. One would have liked to have had some comparative cost figures for these processes and their modifications, and likewise a description of the Deming super-heat process, which should hardly have been omitted from this book. There is a summary of the work done to date in connexion with decolorizing carbons, which materials, it is said, "may become of great value to the industry."

On turning to the part dealing with analysis, the chemist will find an admirable chapter on the polarimeter, one of the most notable features of which is a series of diagrams showing at a glance the optical arrangements of the saccharimeters which have been devised from the time of BIOT (the constructor of the first polarimeter on record) up to the latest modern instruments. It is mentioned as desirable that the half-shadow angle of a polarimeter should be variable, since with light coloured solutions a small angle and low intensity of light can be used with superior sensibility; while when examining dark solutions (as molasses) with a greater angle more light can be transmitted, and observation thus facilitated. In the Bates-Fric instrument, provision is made for the variation of the half-shadow angle with the automatic adjustment of the change in the zero; but since Mr. DEERR penned his lines a British firm has claimed to have perfected a means by which the same object is realized in a practical manner.

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[1] CANE SUGAR. By NOËL DEERR, Fellow of the City and Guilds of London Institute. Second Edition (revised and enlarged). viii + 644 pages Royal 8vo.; 30 Plates (12 coloured) and 360 illustrations in text. (Norman Rodger, 2, St Dunstan's Hill, London, E.C. 3. 1921. 42s. net. (Post free, 43s. 6d. abroad.)

[2] *I.S.J.*, 1921, 637 and 692.

Noël Deerr's "Cane Sugar."

Under the heading of the Assay of Sugar-house Products, a good account is given of the determination of solids by various means, including the spindle, the pycnometer, the refractometer, and the process of desiccation. As one would expect, the determination of sucrose by direct and double polarization is discussed in some detail, a clear and reliable account of both the optical and chemical methods being given. A special chapter is devoted to the determination of reducing sugars. In these analytical sections, the methods described are in general those adopted for roütine work by the Hawaiian Chemists' Association and the Java authorities ; while alternative procedures useful when time is of less account and the greatest accuracy is demanded are also included. Certain methods published in the previous edition of the book, which were not the most suitable for routine work, and were doubtful from the point of view of general reliability, have very rightly been excluded from this new edition.

A chapter to be studied by every sugar factory chemist is that on the chemical control of the process of manufacture, and into it valuable information on most phases of the subject has been compressed. It includes sections on the sampling of cane, bagasse, juice, press-cake, sugar, and molasses ; the control of the milling plant under different conditions ; the interpretation of mill control analyses ; the control of the boiling house ; losses by entrainment and inversion ; the number of analyses necessary ; and stock-taking and balances.

Lastly, there is the chapter on fermentation with reference to the sugar-house, in which subject the chemist has an interest when the factory has a distillery attached. A good account, illustrated by means of plates, is given of the micro-organisms of the tropical distillery in general, and of the yeasts concerned in alcohol production in particular. Outlines of the processes of rum making in Jamaica, Demerara, Mauritius, Java and elsewhere are presented, together with a discussion on the flavour of rum. This chapter concludes with sections on distillery plant, and the control of the distillery. One regrets, however, that an account of the production of industrial alcohol for use as motor fuel or other purpose has been omitted, this being a matter of some interest at the present time, and likely to attract much more attention in the future.

So far chemical matters to which special chapters have been allotted have been mentioned ; but here and there in the text devoted more particularly to what may be termed the agricultural and engineering sections of the book, useful chemical data appear. Briefly, these include the information given on the composition of the cane ; the distribution of the cane into rind tissue and pith tissue and into rind juice and pith juice ; the composition of the cane as affecting economic extraction ; entrainment ; evaporator scale ; composition of sugars ; the deterioration of raw sugar (a remarkably complete summary) ; the valuation of raw sugars ; and finally most of the chapter dealing with the subject of molasses.

Enough, however, has been said to indicate the value of the new edition of Deerr's "Cane Sugar" to the chemist. As already said, it is an indispensable volume, a standard work of reference on most of the problems arising in the production of cane sugar.

Lignite, which has been carbonized, ground to a fine powder, treated with hydrochloric acid, washed with water, and re-ignited, is said to yield a powerful decolorizing carbon, suitable for the treatment of sugar liquors.[1] It has a high carbon content and exceptional porosity. Its decolorizing power is stated to be about 20 times that of animal charcoal.

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[1] *Chemical Age*, 1921, 29, No. 9, 380.

Publications Received.

The Manufacture of Cane Sugar. By Llewellyn Jones, M.I.E.S., and F. I. Scard, F.I.C. Second edition; revised with 270 illustrations and diagrams. (Published under the auspices of the West India Committee by Duckworth & Co., London.) 1921. Price: 25s. net.

A second edition of this excellent work by JONES and SCARD (which has been out of print for some time) has now appeared, and we are pleased to welcome it. As is explained in the preface, it "is not primarily intended to be a scientific exposition of the subject, but rather a guide for the use of those who are connected directly or indirectly with the cane sugar industry otherwise than in a technical capacity." It is thus a book written for the estates proprietor, for the business man interested in sugar production, for the student engineer and chemist, and in short for any who desire a general knowledge of modern machinery and processes used in the manufacture of cane sugar.

We express admiration for the manner in which the authors have carried their purpose into effect. Their several chapters on milling, clarification, boiling and centrifuging, each of which is amply illustrated by well-chosen photographs and drawings, could hardly be more lucid. Special mention should be made of two particularly useful chapters, the first of which lays down the principles involved in chemical control, and discusses the several possible sources of the loss of sugar during manufacture; while the second gives the best of advice on the economical generation of steam, and states the conditions which should obtain to make bagasse the sole fuel of the factory. Lastly, there is a chapter on the utilization of the by-products for the manufacture of rum, industrial 96 per cent. alcohol, "Molascuit," and "Colco."

Sound modern practice only is exposed throughout this book, and no point of much importance for criticism or comment arises. There are, however, two minor statements which may be criticized. It is said (on page 11) that it is doubtful whether the uncrystallizable sugar of cane juice has any rotatory action on polarized light. This assertion (repeated later on page 132) appears to be true only of the juices milled in Demerara, whereas generally speaking the uncrystallizable sugar of the cane juice of the factory certainly has a levo-rotatory action on polarized light.[1] Then (on page 171), in discussing whether the lime or the sulphur dioxide should first be added in the sulphitation process, the authors mention that "it can readily be understood that it is better to obtain this reaction (that of the lime) and subsequently neutralize it with the acid than to acidify and subsequently neutralize with lime." This opinion seems open to question, experiments having been carried out with cane juice in which apparently the same clarifying effect resulted with the sulphitation process whether the alkali was added before or after the acid. Both the sulphitation and carbonatation processes appear to exert a physical (adsorptive) rather than a chemical effect. In De Haan's process of carbonatation the lime and carbon dioxide are allowed to react simultaneously, so that neither is in excess at any time, and yet the effect is at least as good as when the lime is first allowed to react alone.

However, these differences of opinion do not bear on the value of the book, this second edition of which we again highly recommend to those, unpossessed of special technical training, who desire to obtain a general knowledge of the machinery and processes used in modern cane sugar manufacture. It forms an excellent introduction to the subject, and we consider its publication should do much in the way of urging the adoption of modern machinery and modern methods in the manufacture of cane sugar.

La Fabrication de l'Aero-Levure. By Chas. van Damm. (Dunod & Pinat, 49, Quai des Grands Augustins, Paris, France). 1921.

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[1] Refer to Dr. Browne's instructive paper on the low optical activity of the invert sugar present in the raw sugars made in British Guiana, *I.S.J.*, 1919, 623.

Publications Received.

Confectioners' Raw Materials. By James Grant, J.P., M.Sc., F.I.C., Head of Foodstuffs Department, College of Technology, Manchester; and Lecturer in the Victoria University, Manchester. (Edward Arnold & Co., London.) 1921. Price: 8s. 6d. net.

A concisely written work dealing with the raw materials used in the manufacture of confectionery in clear and simple language has long been desired for the use of students of this industry. Mr. Grant's book, however, is by no means of the type required to fill the lacuna. Its subject matter is badly proportioned, and it contains a considerable number of serious inaccuracies, as the following will show.

Eight pages are devoted to confectionery fats, which, considering the importance of the subject, is certainly an inadequate space. One short paragraph suffices to cover the important materials known as compound lards, and it is stated that "these are intimate mixtures of low qualities of vegetable and animal fats bleached as white as possible." While "low" undoubtedly describes the nature of the fatty materials used in the early days of the lard substitute industry, it has only a very limited application at the present time. Eggs and egg powders are also given 8 pages. In describing the preparation of dried white of egg, it is stated that drying is conducted under a partial vacuum; whereas the fact is that the great bulk of the product now marketed is dried either in shallow pans in heated rooms, or by the well-known spray process. In spite of the statement to the contrary, the product dried by either of these processes can be used on being emulsified for both sponge goods and cake work by blending with liquid yolk. It is incorrect to say (as is done) that the preserved broken eggs imported from China and other Asiatic countries are generally mixtures of eggs of land, water, and sea fowl. The paragraph dealing with desiccated eggs is full of inaccuracies; and the analysis given for "Eggo" is obviously wrong, no dried egg or yolk ever showing so low a content of fat and so high a percentage of protein. In the chapter treating of the aëration of confectioners' goods, it is said that cream powder contains calcium sulphate as a weighting material; but this is inexact, since even when this substance is in excess of 2 per cent., it has rarely been added, being a product of the reaction. No references whatever are made to the use of acid phosphate of soda and acid pyrophosphate of soda powders, both of which are largely used in confectionery at the present time.

Carbohydrates are treated in a similarly unsatisfactory manner. One is told, for example, that the use of sawdust for the production of glucose is of common occurrence; that the waste juices from bagasse are worked up into low grades of sugars; and that in beet sugar manufacture the slices are ground to a fine pulp for extraction. Incidentally the reader is also informed that SIGMUND STEIN was the editor of *The Sugar Cane*, whereas actually this "expert" was never associated in any capacity with either our predecessor or with this publication save as an ordinary contributor who was solely responsible for his own signed articles.

Then sugar refining is quite inadequately outlined, the affining operation, for example, being omitted; Fig. 24 represents a fanged beet, not a normal one; and the formula for stachyose is inaccurately given, that sugar being a tetrasaccharide. Thus, we might go on almost indefinitely were space available. The work is in short a most disappointing production.

Comparison of "Alcogas" Aviation Fuel with Export Aviation Gasoline.[1] By V. R. Gage, S. W. Sparrow, and D. R. Harper. Report No. 89; Bureau of Standards. (Government Printing Office, Washington, D.C., U.S.A,) 1920.

"Alcogas" contains about 40 per cent. of alcohol, 35 of gasoline, 17 of benzol, and 8 of other ingredients, the exact composition and method of manufacture being a trade secret. Tests are here described comparing its performance with aviation gasoline in respect of: brake horse-power; fuel consumption; thermal efficiency; and engine performance. In general, in these tests very favourable results were obtained with the alcohol fuel, for details of which reference should be made to this Report.

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[1] See also *I.S.J.*, 1921, 330, 533.

Trade Notices.

Evaporating Plant. (Blair, Campbell & McLean, Ltd., Govan, Glasgow; and Sardinia House, Kingsway, London, W.C. 2.) 1921. Free on application.

This catalogue partakes to some extent of the nature of a technical bulletin, in which, in addition to descriptions of numerous types of apparatus, one finds a good deal of useful information relating to the subject of evaporation generally. Messrs. Blair, Campbell & McLean are sole manufacturers of the "Multiplex" (multiple effect) and "Simplex" (single effect) film evaporators, which have found great favour in a number of industries both in this country and abroad. In the "Multiplex" the effects are usually superimposed, thus providing an apparatus which is economical in respect both of floor-space and particularly of cost of construction and erection; while, moreover, the operation of the apparatus is both easy and continuous. Tables are given showing the number of lbs. of water evaporated per lb. of steam under normal conditions of work and a ratio of 7 : 1 in the boiler. These show 11·62, 19·25, and 23·5 in double, triple and quadruple effect respectively in the case of the "Multiplex" film evaporator using exhaust at 0–5 lbs. An interesting point is that Messrs. Blair, Campbell & McLean can provide (when the b.p. of the liquid under treatment is low) the addition to the triple of an apparatus for the re-utilization of the exhaust steam by thermo-compression with steam jet compressors; but this is recommended only when it has been necessary to employ live steam instead of exhaust for the heating of the plant. This system of thermo-compression is more usually employed in the case of a "Simplex" evaporator using live steam; and it is stated that whereas under average conditions an ordinary single effect evaporator requires 10·5 lbs. of steam per gallon of water evaporated, in the "Simplex" with thermo-compression this consumption is reduced to 6·5 lbs. Messrs. Blair, Campbell & McLean also construct standard triple and quadruple effect evaporators and coil and calandria vacuum pans, such as are particularly in favour in various parts of the sugar-producing world, and are also well known as suppliers of all classes of sugar machinery and distillery plant[1] This catalogue is excellently illustrated. It contains an amount of interesting reading matter; and is a publication that should be in the hands of every sugar factory and refinery engineer. It is obtainable on application.

Laboratory Apparatus and Reagents. (Arthur H. Thomas Company, West Washington Square, Philadelphia, U.S.A.) 1921.

This is a well-illustrated catalogue of general apparatus and reagents for use in laboratories, showing the very wide range of specialities for which the ARTHUR H. THOMAS Co. (founded in 1728 by Benjamin Franklin) is well known. Requisites for the sugar factory and refinery laboratory are well represented in this catalogue, such as mills, polariscopes, refractometers, hydrometers, balances, glassware, etc., the range of which here listed is particularly wide. Noticeable also are the descriptions of certain specialities devised by Dr. G. L. SPENCER, namely: sucrose and glucose pipettes; crucible holder; electric drying oven (for bagasse, and the like); and rotary digester. This catalogue is excellently edited. It gives in the case of the more important apparatus a concise description with particularly good illustrations; while for some of the newer specialities there are notes which make interesting reading for chemists desirous of being in touch with the latest developments in analytical and physical apparatus. For example, on turning to the section dealing with polarimeters and saccharimeters, one finds a good description of the Bausch & Lomb instrument with views of its optical system, and details of its mechanical construction.

Scientists' Reference Book and Diary, 1922. (James Woolley, Sons & Co. Ltd., Manchester.) 1922. Price: 3s. 6d.

Woolley's Scientists' Diary is a particularly handy little book. In addition to the pages for the writing of a short diary, it contains reference data relating to recent developments in physics and chemistry; physics; chemistry of agriculture; light and heat; thermometry; electrical measuring instruments; electrical units; and mensuration of surfaces and solids. It has a special section on chemical data; and is therefore a most useful and practical compilation, containing quite a remarkable amount of reliable information.

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[1] See *I.S.J.*, 1921, 513.

Brevities.

We have received samples of granulated sugars made at the Cantley Beet Sugar Factory, Norfolk. A sample of the first sugar made during this season was good, but only moderately so; but the latest received represents an excellent product, equal to the best American granulated in colour and in grain.

According to the *Times Trade Supplement*, French trade with Mauritius is to be developed by the purchase on the part of a Paris Association of two of the principal Mauritius stores. Under the new management all kinds of French goods will be imported direct from French manufacturers and retailed.

After 15 years experimenting by the H.S.P.A. at a cost of about $250,000, there now appears to be promise of the construction of a practicable cane loader.[1] Various forms are now on trial embodying the principle of a mechanical conveyor, mounted on a truck or tractor, by means of which arrangement the bundled cane is lifted from the ground and delivered to the waiting cars.

A recent number of our valued contemporary, *Sugar News*,[2] shows a photograph of an immense heap of bagasse lying outside a factory in the Philippines It is entitled "The Surplus Bagasse Problem," and is a picture that probably would incite envy in most sugar producing countries. The causes leading to the production of an excess of bagasse, and a method for its disposal, were recently discovered by Mr. R. Renton Hind.[3]

Recently the National Wholesale Grocers' Association of America completed an examination of the products sold by a large number of stores in various parts of that country, in order to indicate the percentage sales of commodities.[4] Sugar leads so far as foodstuffs are concerned, as the first six returns shows:— Sugar, 13·6; butter, 12·9; cured meats, 11·5; canned milk, 7·6; fresh fruit and vegetables, 5·6; and soap, 5·5 per cent.

In 1919 and 1920 the export from Formosa to Japan of alcohol was 2,810,860 and 1,798,274 gallons respectively, about 80 per cent. of this being used industrially.[5] Owing to competition from Java, the exports from China have increased during recent years, while the amount shipped to Hong Kong which in 1917 was 294,360 gallons is now only 3960. Molasses is still the chief raw material, but it is stated that now rice and potatoes are also being used.

By his comparative early death at the age of 47 the sugar industry of Natal has lost a valuable and highly esteemed official in the person of Mr. William King, F.C.S., for the past seven years chief chemist to the Zululand Sugar Milling Co., Ltd. He received his early training with the sugar refineries at Greenock and at the Royal Technical College, Glasgow. In 1897 he went to Natal as chief chemist to the South African Sugar Refineries at Durban, and previous to moving to Zululand gave valuable service to the technical college at Durban as Lecturer on Chemistry.

Mr. Geoffrey Fairrie, of the firm of Fairrie & Co., Ltd., Liverpool, delivered on November 8th, 1921. an interesting and instructive lecture, at Leeds, on the value of sugar as a food. He discussed the place of sugar in the diet of the average individual as an economical source of energy. A table was presented showing the calories per penny available at the current prices for various foods, some of the items mentioned being as follows: Sugar, 338; bread, 437; potatoes, 248; cheese, 122; butter, 146; beef, 50; and bacon, 127. Mr. Fairrie stated that pure confectionery, such as boiled sweets, constitutes the safest and cheapest source of energy for children; and controverted the idea that sugar causes teeth to decay, evidence to the contrary having been established by a committee of dentists. He also discussed the *per capita* sugar consumption of different countries, and showed that "there has been a gradual but definite increase all the world over in the unconscious appreciation of sugar as a cheap palatable source of bodily energy, which has caused the world's production to multiply almost ten times, from 1·75 million tons in 1860 to 16·5 million tons in 1914."

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[1] *Facts about Sugar*, 1921, 12, No. 24, 466. [2] 1921, 2, No. 10, 412. [3] *I.S.J.*, 1921, 587. [4] *Lefax*, December, 1921. [5] *J. Soc. Chem. Ind.*, 1921, 40, No. 22, 433R.

Review of Current Technical Literature.[1]

COMPARISON OF DECOLORIZING CARBON MADE FROM BEET CARBONATATION SCUMS WITH ANIMAL CHARCOAL. Zdenek Vytopil. *Listy Cukrovarnické, 1921-2, 70; Zeitsch. Zuckerind. Cecho. Republic, 1921, 45, No. 9, 85-89.*

Beet carbonatation scums were dried, and carbonized by heating for four hours at about 500°C., when a product containing 2·52 per cent. of carbon, 89·8 of calcium carbonate, and 0·30 per cent. of sand and clay was obtained. In comparison with decolorizing carbons, such as "Carboraffin," "Norit," and "Eponit," this carbonized press-scum was found to be much inferior, but compared with new animal charcoal in the form of fine grain, its decolorizing power was about the same under identical conditions of testing, namely, heating to 90–98°C. for 30 mins. Its aqueous extract was clear and colourless, and reacted strongly alkaline, due no doubt to the presence of calcium hydroxide in the scums, and also to the presence of potassium carbonate. It could be readily sweetened off after use, and in order to reduce its sugar content to about 0·5 per cent. about 1000 per cent. of water was found necessary. However, its power of adsorbing inorganic substances from sugar liquors was very low compared with char, especially in respect of calcium compounds, and in consequence its application caused no appreciable increase in the purity of the product treated.

Further experiments on the possible utilization of such a decolorizing material are considered desirable by the author. Preliminarily, he has calculated that the cost of making 1000 quintals is 89,500 Kc.,[2] i.e., 2250 quintals of scum with 60 per cent. of water at 2 Kc., 4500; 500 quintals of coal at 40 Kc., 20,000; grinding, etc., 2000; wages for 125 days, 33,000; and repairs and depreciation, 30,000. Then he proceeds to estimate the cost of using this charred material in comparison with char. In the case of the refinery taken as an example, 15,000 quintals of white sugar are produced during 107 days, using 4 per cent. of bone char, taken on the output. Materials (char, filter-cloths, wages, sugar losses, repairs and depreciations) cost 235,600 Kc.; and the cost of revivification (acid, caustic soda, steam and coal, water, wages, repairs and depreciations) amount to 196,024, a total of 431,624, from which 10,005 the worth of the spent char is deducted, leaving 421,619 Kc. as the total cost of the filtration using char. In the case of the carbonized scum, the liquors from the mechanical filters would be treated with it during 30 mins. at 90–98°C., and passed through the scum filter-presses, no attempt at revivification being made. It was estimated that the cost of using this material so as to produce the same decolorization as with char would be 245,000 Kc. (including the charred scum, filter-cloths, wages, loss of sugar, and repairs and depreciations), that is about 40 per cent. less than in the case of char.

DIFFICULT BOILING OF AFTER-PRODUCTS IN THE BEET FACTORY IMPROVED BY THE ADDITION OF RESINS AND VEGETABLE OILS. H. Zscheye. *Deutsche Zuckerindustrie, 1921, 46, 626 and 645,*

This year in Germany the after-products of the beet factory are showing an extraordinary tendency to froth (especially where the roots have undergone an unusually long period of dryness), and rise high in the pans, it being difficult, if not impossible, to concentrate them to the desired density. When the after-product has reached a certain concentration, the temperature falls, the steam-chamber assumes the pressure of the heating steam, the vacuum increases, and the strike moves slower and slower till it becomes quiet, and boils no longer. This condition of affairs was not ameliorated by the addition of sodium carbonate to the thin-juice, or by the injection of steam in the manner recommended by CLAASSEN. Recourse was had to the addition of varnish, and linseed or rape oil; and the result was surprising, the temperature rising rapidly, the pressure in the heating chamber falling, the foaming strike slowly returning to its natural volume, and boiling proceeding as easily as with the best of after-products. Two litres were used to the strike of 600 quintals (60 tons),[1] the first shortly after drawing in the after-product, and the second when the contents of the pan had reached 88-89° Brix, using the suction cock or the testing cock (but never the butter cock), so as to effect admixture with the mass from below and throughout. It is believed that as the result of the dry season the roots contain an unusual amount of organic impurities, transformed during liming and carbonatation into calcium organic acid salts, which during boiling form a solid skin on the surface of the strike, preventing the elimination of the bubbles of steam. By the addition of the resin or vegetable oil, it would seem that these lime salts are transformed into insoluble compounds, which sink to the bottom of the pan, enabling the mass to boil in a normal manner.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*)

[2] That is the Czecho-Slovakian crown, 250 of which at the present moment are equivalent to £1.

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LUBRICATION OF SUGAR MILL MACHINERY. *Anon.* *Lubrication, 1920, 6, No. 9, 1-8.*

Steam cylinders of mill engines, steam tractors, locomotives, etc., should be lubricated with a high-grade cylinder oil of about 130 seconds Saybolt viscosity at 210°F. If the main engines are condensing or use superheated steam a "straight" mineral cylinder oil can be used, but for ordinary auxiliary engines compounded oil is preferable. If it is desired to carry a single cylinder oil, one with a light compound is recommended as meeting all conditions most satisfactorily. For internal combustion engines of tractors, it is advisable to carry an oil of 500 to 750 viscosity, especially designed for the purpose. Any oil of the above viscosity can be used, and may give fair results if the cylinders are cleaned frequently, but a special non-carbonizing oil is preferable. For the bearings, guides, links, eccentrics, etc., of mill engines a straight run oil of 300 to 500 viscosity will give satisfaction, the heavier, larger engines naturally requiring the higher viscosity oil. For light engines, dynamos, etc., an oil of 200 to 300 viscosity should be used. For centrifugals, on account of their high speed and exact construction, a fully refined, filtered oil is to be preferred, and usually one of 200 viscosity will operate well.

For the lubrication of the mill rolls, crusher and gear bearings, on account of the high pressures a heavy bodied lubricant is necessary. Ordinary oils have not sufficient viscosity to keep the surfaces apart on account of the comparatively slow speed and heavy pressures. A lubricant of about 200 viscosity at 210°F. seems to meet the requirements, and a straight petroleum product seems to give better results than a grease or compound. This type of lubricant also has the advantage of adhering tenaciously to the bearing and of not being worked out by the variations of pressure to which the roll bearings are subjected. A compound having a viscosity of about 1000 secs. at 210°F. is most suitable for gears. It should be very adhesive to metal and of such a consistency that it will not drip, while still being sufficiently plastic to furnish good lubrication. Lastly, for the lubrication of the moving parts of locomotive machinery, as eccentrics, links, guides, etc., a locomotive engine oil of from 400 to 450 viscosity at 100°F. should be used; while for cane cars a summer black oil meets all needs. Throughout the plant there are many places where grease is necessary, and probably two grades will satisfy all conditions, but for wagons axle grease is much cheaper.

EQUIPMENT OF THE MODERN BEET FACTORY. *H. Claassen.* *Zeitschrift des Vereins deutscher Ingenieure, 1921, 65, 545-548, 571-573.*

Dr. CLAASSEN outlines the means which recently have been recommended, and in some cases adopted, for the unloading and the conveying of beets *en masse* to the factory. For example, for discharging the roots from the railway trucks a blast of compressed air and water has been used. Sketches and short descriptions are given of: Steffen's scalding process of extraction; the return of clarified waste-waters to the diffusion battery; the Hyross process of "press diffusion"; and the "Rapid" method of extraction. Drawings are also presented of types of sand-filters, evaporators, pans, and crystallizers in use in the German beet industry.

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[1] Varnish of course contains a "drier" in the form of a metallic oxide, litharge often being used, and unless the after-product were remelted and the liquor filtered, this would pass into the raw sugar produced, though the amount would certainly be small. One of the vegetable oils, therefore, would seem a preferable addition.—ED., *I.S.J.*

Qualitative Test for Sucrose in the Presence of Dextrose, using Ethyl Acetate.

L. A. Congdon and C. R. Stewart. Journal of Industrial and Engineering Chemistry, 1921, 13, No. 12, 1143-1144.

A number of solvents (including acetic acid, *p*-xylene, toluene, benzene, carbon tetrachloride, carbon bisulphide, and acetone) were examined with the purpose of finding one differentiating between sucrose and dextrose. In the case of ethyl acetate it was found when 1 grm. of the mixed sugars was extracted in filter-paper thimbles in a Soxhlet apparatus during five hours that the dextrose was almost completely dissolved out, while the sucrose remained only slightly affected. This procedure is therefore claimed as a new qualitative test for the separation of sucrose and dextrose in mixtures. Levulose and other sugars were not examined in respect of their solubility in ethyl acetate.

Determination of Sucrose in Table Syrups, Artificial Honeys, Invert Sugars, etc., in the Presence of Dextrins.

G. Bruhns. Chemiker Zeitung, 1921, 45, 661-664, 681-682, 685-687, and 711-712.

On analysing "artificial honey," as prepared in German beet factories by the hydrolysis of syrups obtained on remelting white syrups, it has been observed for some time past that the sum of the sucrose (by double polarization) and the invert sugar is 3-5 per cent. less than the total solids, as found by means of the pycnometer. This difference is due to the presence of dextrin-like condensation products, formed during the hydrolysis of the syrup, which products are only partially hydrolysed by the hydrochloric acid under the conditions of the double polarization method.[1] It is therefore concluded that the double polarization method is inapplicable in the examination of such "honeys," except when the hydrolysis has been incomplete and a large proportion of sucrose is present. A close approximation to the truth is realized by effecting the complete hydrolysis of the dextrins. This is done by preparing five solutions containing 2·5 grms. of the "honey" and 15 c.c. of N/1 HCl in 250 c.c. of water, and heating for varying durations (4-11 hours) until the maximum cupric reducing power is attained, a correction being made for the levulose destruction by reference to a table given in this article. Results for the total invert sugar agreeing within about 0·5 per cent. with the total solids were then obtained.[2]

Sugar Conveying and Elevating System installed at Crockett Refinery, Cal., U.S.A.

Henry T. Hesselmeyer. Facts about Sugar, 1921, 13, 254, 290 and 310.

Mechanical details are given of the following conveying and elevating machinery installed at Crockett by the Meese and Gottfried Co., of San Francisco: docks to warehouse; docks to melt-house; warehouse conveyors; melt-house conveyors; various refinery elevators; conveyor system for the char house; dry char conveyors; refinery to loading station, etc., etc.

Preparation of Mannose from Ivory-nut Shavings.

Paul M. Horton. Journal of Industrial and Engineering Chemistry, 1921, 13, No. 11, 1040-1041.

A method is described, depending upon the extraction of the gums and other bodies hindering crystallization by a preliminary treatment with sodium hydroxide, the hydrolysis of the mannocellulose with cold 75 per cent. sulphuric acid,[3] and the crystallization of the mannose from glacial acetic acid.[4]

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[1] See A. WOHL, *Berichte*, 1890, 23, 2084-2110. This worker hydrolysed a solution containing 13·024 grms. of sucrose with 3·3 c.c. of concentrated hydrochloric acid by heating in a water-bath for ½-hour, cooled, diluted to 100 c.c., and polarized in the 200 mm. tube at 20°C., when a reading of −12·00°V. was observed, from which the quantity of sucrose inverted was calculated to be 95 per cent. When heating was prolonged, lower results (corroborated by results with Allihn's method) were obtained; and it was concluded this low yield was due, not to levulose destruction, but to the formation of dextrin-like compounds by the condensation of dextrose and levulose, mainly the latter. On separating these dextrins bodies by precipitation, their rotatory power was found to be about one-half and their reducing power, about one-third that of levulose. A theoretical yield of invert sugar could be obtained by hydrolysis with 0·01 per cent. acid at 95° during ½-hour, showing that no reversion takes place under such conditions.

[2] A. BEHRE, *Chemiker Zeitung*, 1921, 45, 1002-1003, has published a paper leading to the same general conclusions as BRUHNS. He determines the sucrose by the difference in the iodine value before and after inversion.

[3] BOURQUELOT and HERISSEY, *Comptes rendus*, 1901, 133, 302.

[4] C. S. HUDSON, *J. Amer. Chem. Soc.*, 1917, 39, 470.

Review of Current Technical Literature.

STANDARDIZATION OF FILTER-PRESS PLATES. *Anon.* *Journal of the Society of Chemical Industry, 1921, 40, No. 21, 401-402 R.*

A Joint-Committee of the Association of British Chemical Manufacturers and the British Chemical Plant Manufacturers Association has reported on the possibility of standardizing filter-press plates. As the result of a *questionnaire*, it was found that the sizes of plates of the presses in use in the chemical industry in the United Kingdom fall into four very definite groups: namely 18½, 25, 32 and 38 in. square. These sizes were therefore adopted for standardization, and they include 67 per cent. of the total number of apparatus regarding which reports were received. It was decided that the following details should be standardized: Size of plate and cake (measured on outer and inner edges of joint surface); diameter and centres of side-bars; sizes and position of wash and feed passages; size and nature of attachment of feed-cocks, wash-cocks, filtrate taps, and height of press (between floor and bottom of plates). The Committee is convinced that a distinct economy with increased efficiency in washing is to be obtained in many cases by the provision of a rib or flange about ½ in. deep round the interior of the frames of washing presses on the wash-water outlet side, and it is proposed that this be a standard arrangement. All filtrate and air-cocks should have "cleaning type" nozzles, and facings should be the same for both. Helpful criticism and comment is welcomed by the Committee.[1]

PREPARATION OF A PALATABLE TABLE SYRUP FROM SUGAR BEETS. *Sydney F. Sherwood.* *Journal of Industrial and Engineering Chemistry, 1921, 13, No 9, 799-801.*

It is said that syrups prepared by the author's process[2] from beets grown in southern Michigan were found to be satisfactory, the unpleasant odour and flavour being absent, the colour being amber, and the cloudiness no greater than in average cane or sorghum syrup. Treatment of the hot syrup containing 50 per cent. of solids with 3 per cent. of kieselguhr, and filtration under pressure, resulted in a syrup of an improved degree of clearness. Decolorizing carbon reduced the colour, but not greatly. The author considers his process preferable to either Alexander's[3] or Kestner's,[4] in that the introduction into the extract of semi-soluble and suspended material from cooked and pulped beets is avoided, actual filtration is rendered unnecessary, while the danger of scorching is eliminated. With roots at $7 per ton, the cost of 100 lbs. of the syrup would be only 35 cents. when operating on a small scale in the home, using ordinary pressure cookers, the value of labour not being included[5]

UTILIZATION OF STRAW [AND POSSIBLY OF BAGASSE] FOR THE PRODUCTION OF FARMYARD MANURE *H. B. Hutchinson and E. H. Richards.* *Journal of the Ministry of Agriculture, 1921, 398.*

Experiments have been going on at Rothamsted Experimental Station with the view to making a nitrogenous and humus-forming manure (at least equal to farmyard manure) from straw by bacterial decomposition alone. At the outset it was found that the nitrogen compounds in straw are inert, and play little part in the rotting action of the manure heap, though a considerable proportion of the carbohydrate matter (the starch and pentosans) is easily decomposed, and may be used to fix atmospheric nitrogen. Under ideal conditions the amount of nitrogen so gained may double the original content of the straw. In order to secure a thorough rotting of the straw, resulting from the decomposition of the cellulose and ligno-cellulose, the most important conditions that must be realized are: (*1*) the air supply, typical rotting occurring only under aërobic action; (*2*) soluble nitrogen supply in suitable concentration, in connexion with which point it should be noted that the concentration of even the weakest undiluted urine is above the maximum limit for decomposition, and that no rotting occurs until the amount of ammonium carbonate has been sufficiently reduced by volatilization; and (*3*) temperature, about 35°C. being the optimum. If soluble nitrogen compounds are supplied at the rate of 0·72 parts of nitrogen per 100 of dry straw, all the added nitrogen is converted from a soluble to an insoluble organic form. Rotting will proceed until about 50 per cent. of the dry matter has been lost, during which operation little or no loss of nitrogen occurs.[1]

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[1] Association of British Chemical Manufacturers, 166, Piccadilly, London, W.1.

[2] U.S. Patent, 1,370,372; *I.S.J.*, 1921, 475. [3] *I.S.J.*, 1920, 118. [4] *I.S.J.*, 1920, 115, 289.

[5] See also TOWNSEND and GORE, *I.S.J.*, 1919, 91; BLOCK, *ibid.*, 1921, 17, and 411.

Formula for the Calculation of the Recovery. *B. Serrano.* *Sugar News, 1921, 2, No. 10, 429-430.*

It is said by the author that the following method of estimating the recovery of 96·5 sugar (worked out empirically in the laboratory) has given good results in certain factories in Bais, P. I., for the calculation of the distribution of sugar to the planter :—

$$\frac{\text{Sucrose in crusher juice}}{10} + \frac{\text{Purity of crusher juice} - (166 - \text{extraction})}{100} \times 2 = \text{piculs of}$$

sugar per ton of cane. Thus, in an example given, if the sucrose and purity of the crusher juice are 18·5 and 85·0 respectively, and the extraction 92, the calculation is : $\frac{18{\cdot}5}{10} + \frac{85 - (166 - 92)}{100} \times 2 = 2{\cdot}07$ piculs of 96·5° sugar per ton of cane, as the amount that may be expected under ordinary working conditions. In Bais with cane of 21·8 per cent. sucrose and 94·5 purity the figure calculated was no less than 2·7 piculs of sugar per ton of cane. Planters there have adopted this formula, and have found that the amount actually obtained approximates quite closely to that predicted from the formula, being sometimes above, but never less. Criticism of this method of calculating the anticipated recovery is welcomed by the author.

Calculation of the Proportion of Sugar distributed to the Planter in Payment for Cane. *Carlos L. Locsin.* *Sugar News, 1921, 2, No. 10, 421-423.*

Contributing to the discussion on this subject,[2] the following modification of Mr. Thurlow's proposed standard method is offered: (*1*) That the mixed juice purity for each planter's cane can be computed daily (if a daily distribution of sugar is made) by multiplying his crusher juice purity by the daily ratio of the purity of the mixed juice to the purity of the crusher juice (i.e., the "mixed juice factor" for the day), and (*2*) that from each planter's mixed juice purity, an individual boiler-house recovery be computed for that planter. Thus, the yield of sugar from each planter's cane would be made to depend on its sucrose content and on its purity, the first determining the relative quantity of sucrose that each planter introduces into the factory, and the second the percentage of that sucrose that may be converted into 96° sugar. If this latter statement be correct, it is obviously wrong that each planter's recovery be deducted from the average boiling-house recovery as determined by the average mixed juice purity. Further, the author does not favour the use of a factor of factory efficiency of a previous season's run, but believes that every week's sugar should be entirely distributed that week, making a correction on the calculated sugar by the sugar actually produced, that is, that the efficiency factor every week for that week should be used. This modified method of distribution would involve: (*a*) the crusher juice analysis from the cane of each planter, the ratio of the purity of the mixed juice to the purity of the crusher juice, and the mixed juice purity for each planter; (*b*) the constant K, that is the Java ratio × mill extraction; (*c*) each planter's factor of recovery for 96° sugar corresponding to his mixed juice purity; (*d*) and the ratio of the produced to the calculated sugar. Then the polarization of the crusher juice × (*a*) × (*b*) × (*c*) × (*d*) = actual per cent. of 96° sugar recovered.

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[1] In an article in the daily press published since the above article was written, it is said that "Practical difficulties have recently been overcome. The straw is twice moistened with water, and after a short interval treated a third time with a cheap chemical solution. Invisible bacilli do the rest. The product looks like farmyard manure and may produce at least as good results. Farmers are stated to be immensely impressed by the appearance of the product."

[2] *I.S.J.*, 1921, 621-623.

COMMENTS ON THE CHEMICAL CONTROL DATA OF THE PHILIPPINE CENTRALS. *E. T. Westly. Sugar News, 1921, 2, No. 10, 424.*

On the whole the data concerning the 10 Philippine Centrals recently published[1] is fairly complete ; but the author thinks that a few more figures might have been included. He has calculated the loss per 100 of cane and per 100 polarization in the cane, and the principal average figures for the factories, these additional data being as follows:—

Loss per 100 Cane .. 0·002.. 2·32.. 2·55.. 2·24.. 2·35.. 2·12.. 2·03.. 2·50.. 2·66
Loss per 100 pol. in Cane 0·023..16·45..17·61..19·78..17·63..17·28..16·89..18·17..18·06

Polarization per cent. Cane	12·96	average	of 10	factories.
Fibre per cent. Cane	11·48	,,	,, 10	,,
Tons Cane per ton Sugar	8·94	,,	,, 10	,,
Piculs Sugar per ton Cane	1·17	,,	,, 10	,,
Polarization per cent. Sugar	96·27	,,	,, 9	,,
Loss per 100 Cane	2·289	,,	,, 8	,,
Loss per 100 pol. in Cane	17·616	,,	,, 2	,,
First expressed juice, Brix	18·99	,,	,, 10	,,
,, ,, ,, Apparent purity	83·03	,,	,, 10	,,
Last mill juice, Brix	5·61	,,	,, 10	,,
,, ,, Apparent purity	70·58	,,	,, 10	,,
Mixed juice, Brix	16·44	,,	,, 10	,,
,, ,, Apparent purity	80·35	,,	,, 10	,,
Syrup, Brix	62·13	,,	,, 10	,,
,, Apparent purity	82·00	,,	,, 10	,,
Bagasse per cent. polarization	3·76	,,	,, 10	,,
,, ,, moisture	47·28	,,	,, 9	,,
Press Cake per cent. polarization	4·92	,,	,, 10	,,
,, ,, cane	1·56	,,	,, 8	,,
Final molasses, Gravity solids	87·05	,,	,, 9	,,
,, ,, Apparent purity	32·84	,,	,, 7	,,
,, ,, Gravity purity	40·03	,,	,, 7	,,
Tons Cane per hour	45·75	,,	,, 10	,,
Extraction per cent. sucrose in cane	93·41	,,	,, 10	,,
Dilution per cent. normal juice	13·94	,,	,, 10	,,

In regard to the first mill of the series,[2] if the tons of polarization in the sugar be calculated and subtracted from the 4816·23 tons of polarization in the cane, the loss indicated is only 1·13 tons. There is, therefore, obviously an error in certain of the figures recorded for this mill, leading to such a loss per 100 of cane as that shown.

PAYMENT OF THE CANE FARMER IN SUGAR ON THE BASIS OF THE SUCROSE CONTENT OF THE JUICE. *Isidore A. Colon. Facts about Sugar, 1921, 12, No. 26, 510-511.*

In an address recently delivered by the author,[3] it was pointed out that formerly in Porto Rico the *colonos* were paid so much sugar for their cane on the basis of weight, the amount varying in recent years from 6 to 7·5 per cent. This is, of course, an inequitable system, since the farmer delivering good cane with 18-20 per cent. of sucrose and a purity of 90 gets no more than another with material having 12–14 per cent. of sucrose and a purity of only 70. Some years ago the Fajardo mill established a system of payment based on the sucrose content, the *colono* being allowed $\frac{9}{16}$th or 56·25 per cent. of the yield of his cane in sugar, calculated by the following formula: $(S - BP)\ F$, in which S is the sucrose content of the undiluted juice (i.e., from the shredder) ; B, the Brix of the undilute juice (also from the shredder); P, the purity of the final molasses divided by 100, and F, a factor to be determined according to the results of the mill during preceding years, taken as 1·14 at the mill mentioned.

J. P. O.

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[1] *I.S J.*, 1921, 688.

[2] See *I.S J.*, 1921, 688.

[3] Mr. COLON is Professor of Chemistry in the University of P.R., and Manager of the P.R. Fertilizer Co.

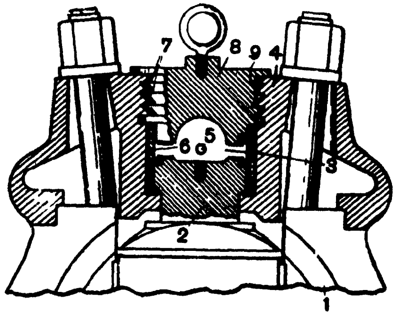
Review of Recent Patents.[1]

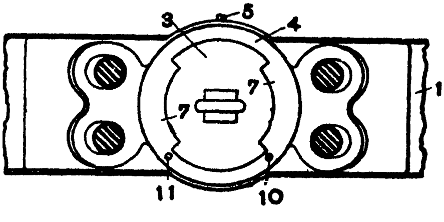
UNITED STATES.

Quickly Removable Breech-Block for the Hydraulic Cylinders of Mills.

Charles T. Ericsson (assignor to *Birmingham Machine and Foundry Co.,* of Birmingham, Alabama, U.S.A.). *1,369,014.* February 22nd, 1921.

A hydraulic breech-block is provided requiring no disconnection of hydraulic piping or any other parts, and no unscrewing of bolts except one small lock bolt, in order to lift out the breech-block and piston of the cap. The particular object of the construction is to obtain the greatest strength of attachment for the block with the least time required to remove and replace it. This is attained by the provision of a breech-block having teeth on its opposite sides which can with a quarter-turn be brought into engagement with similar teeth in the top-cap of the cylinder. A further object of the invention is to provide the breech-block with a pair of lugs which co-act with a fixed pin to arrest the block in engaged or disengaged position, a removable stop-pin being also provided to co-act with the other in engaging said lugs so as to positively hold the breech-block against rotation in the top-cap.





In the illustration is shown a mill provided with a ram *2* working in a hydraulic cylinder *3* in its top cap *4*. The water inlet *5* is taken through the side of the cap and tapped into the heavy brass bushing *6* near its middle. In the top-cap there are a number of circular saw-tooth-shaped teeth *7* cut, which extend only through an arc of 90°, less clearance, on two opposite sides of the cylinder, as indicated in the plan drawing, and the breech-block *8* has corresponding teeth *9* cut to gauge so as to accurately match teeth in the cap. When working, the breech-block is in position with all of its teeth *9* engaged with teeth *7* in the cap and is so held by a pin *10* and a tap bolt *11* which match in the oppositely facing hook lugs *12* spaced 90° apart on the top of the breech-block and disposed to overlap the top-cap. The pin is made fast in the top 90° removed from the threaded hole tapped in the cap for the bolt *11*. In order to lift out the breech-block, all required is to unscrew the bolt *11* and turn the breech-block around 90° by means of a wrench fitted over the square *13* on top of the breech-block, until the slot in the breech-block comes to positive stop against pin *10*, when the breech-block can be lifted out. To replace the block, it is lowered back into the cylinder with its teeth *9* just clearing the cap teeth *7* and is given a 90° turn which again engages the teeth, after which the bolt *11* is screwed back in place and the lugs *12* are held by the bolt *11* on one side and the pin *10* on the other. The idea of having a plurality of circular teeth *7* and *9* is to distribute the pressure on as large a surface as possible.

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[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2fr. 00 each).

Patents.

Use of Spent Kieselguhr as a Heat-Insulating Material. *A. H. Krieger and W. L. Jordan. 1,393,225.* October 11th, 1921.

Kieselguhr which has been used for the filtration of sugar juices or syrups is moulded, dried, and used as a heat-insulating material, the non-sugars which have accumulated in it during use acting as a binder.

Treating Distillery Slops (Spent Wash or Vinasse) for the Recovery of Volatile Acids. *A. A. Backhaus and Carl Haner, Jr.* (assignors to *U.S. Industrial Alcohol Co.,* of West Virginia, U.S.A.). *1,396,006; 1,396,007; 1,396,008; 1,396,009; 1,396,010; 1,396,368.* November 8th, 1921.

Claim is made for the process of treating distillery slops, comprising concentrating it, adding caustic soda, heating at a temperature from 175–250°C., adding lime to form calcium oxalate, filtering, evaporating the filtrate to dryness, and distilling with sulphuric or oxalic acid to recover the volatile acids.

Beet Toppers. (1) *Marion A. Smith,* of Salt Lake City, Utah, U.S.A. *1,389,708.* September 6th, 1921. (2) *G. B. and W. A. Hayes. 1,390,289.* September 13th, 1921. (3) *Samuel J. Wilson,* of Roberts, Idaho, U.S.A. *1,393,871.* October 18th, 1921.

Beet Harvesters. (1) *Jos. E. Wyckoff,* of Los Angeles, Cal., U.S.A. *1,390,663.* September 13th, 1921. (2) *Lawrence Adams,* of Layton, Utah, U.S.A. *1,390,261.* September 13th, 1921.

Beet Loader. *William Mable,* of Fort Collins, Colo., U.S.A. *1,378,705.* May 17th, 1921.

Beet Blocker. *Stephen Donner,* of Toledo, Ohio, U.S.A. *1,394,152.* October 18th, 1921.

Production of Alcohol from Gas containing Ethylene. *Cleburne A. Basore,* of Auburn, Ala., U.S.A. *1,385,515* (re-issue, *15,211*). October 25th, 1921.

Water (50–70 per cent. by vol.) is added to a mixture of sulphuric acid and ethyl hydrogen sulphate, and the resultant reacting constituents heated in a closed vessel, the alcohol then being distilled off.

Centrifugals. (1) *G. H. Elmore,* of Swarthmore, Pa., U.S.A. *1,342,743.* June 8th, 1920. (Four figures.) (2) *Meredith Leitch,* of Poughkeepsie, New York, U.S.A. (assignor to the *De Laval Separator Co.,* of New York). *1,370,326.* March 1st, 1921. (3) *James J. Hay,* of Bellows Falls, Va., U.S.A. *1,388,339.* August 23rd, 1921.

Means for excluding Dirt and Liquid from the Bearings of Centrifugal Machines. (1) *Meredith Leitch* (assignor to the *De Laval Separator Co.,* of New York). *1,386,122.* (2) *Bert R. Wright* (assignor to the *De Laval Separator Co.,* of New York). *1,386,148.* August 2nd, 1921.

Evaporator, using Compressed Vapour. (1) *William L. de Baufre,* of Annapolis, Maryland, U.S.A. (1) *1,361,834.* December 14th, 1920. (Two figures.) (2) *1,387,475; 1,387,476.* August 16th, 1921.

Vapour produced in the evaporator, so-called "secondary vapour," is withdrawn by ejectors where it is combined with the primary vapour, compressed, and then forced into the heating space of the evaporator. Means, electrical or mechanical, are provided for automatically operating the valves of the ejectors according to the level of liquid in the storage tank.

Discharger for Sugar Centrifugal Machines. *Edmund Daniels*, of Lahaina, T. H. *1,388,173.* August 23rd, 1921. (Ten figures.)

Fig. 2 shows a vertical elevation of the apparatus; Fig. 8 a sectional plan view of the mounting for the plough spindle: and Fig. 10 a longitudinal section of the plough. In using this discharger, it is moved to inoperative position by swinging the handle *43* in a clockwise direction, so that the plough is disposed toward the centre of the basket. After a sufficient quantity of sugar has been deposited upon the inner wall of the basket and it is desired to discharge the cake, the pawl *64* is swung to bring its left-hand member into engagement with the rack *60*. The plough spindle *10* is locked to the collar *7* by rotating the handle *43* on its axis to force the plunger *41* into engagement with the spindle *10*. The collar *7* and the spindle *10* are then moved in an anti-clockwise direction until the cutting edge *17* of the plough engages the sugar cake and begins to cut the same in a circular path, due to the rotation of the basket. The plough is advanced by successive steps in its cutting operation by continued rotation of the spindle *10* by means of the handle *43*, the successive cuts being indicated by the left-hand end of the pawl *64* engaging the successive ratchet teeth. When the pawl engages the final yielding tooth *70* of the ratchet the plough has reached the end of its cutting operation, at which time scraper blade *23* is forced by the springs *26* against the remaining layer of sugar adjacent the inner wall of the basket and is effective in scraping off said layer of sugar without damaging the basket. The cutting edge of the knife is prevented from coming into contact with the wall of the basket at any time by the set screw *53*, carried by lug *52* on the collar *7*, coming in contact with the fixed lug *54* on the plate *9*. After the plough has been advanced to its outer limit in the cutting operation it is gradually fed downward, by turning the hand-wheel *31* until it reaches the lower limit of its travel, when all of the accumulated sugar will have been cut away from the basket wall. When this has been effected, the plough is swung to its inoperation and the spindle elevated to its upper limit by reversing the movement of the hand-wheel *31*, which causes the gear *35* to move the spindle *10* upwardly. When said spindle reaches its upper limit, a spring latch *100* secured to the side of hub *5* snaps under a flange *101* on the hub of the plough and serves to support the spindle and plough, thereby relieving the operating mechanism of unnecessary strains due to the weight of the spindle and plough.

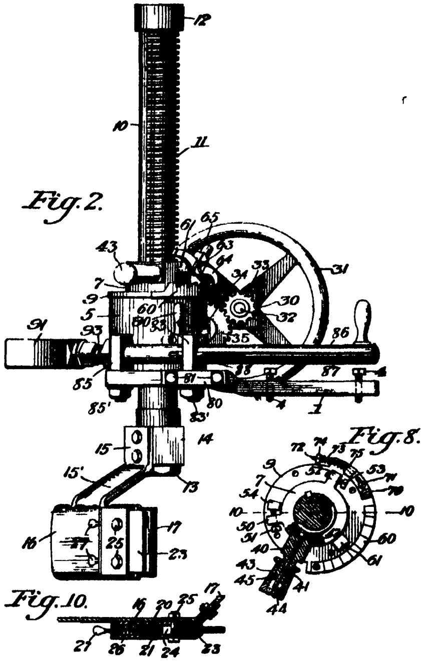


Fig. 2.

Fig. 8.

Fig. 10.

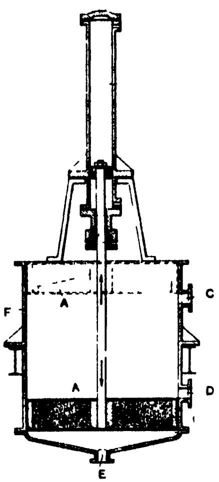
UNITED KINGDOM.

Utilization of Molasses for Yeast Manufacture. *A. Wohl*, of Langfuhr, Danzig, Germany. *169,504* (*17,079*). June 23rd, 1920.

In order to invert and at the same time sterilize the molasses, it is treated before dilution with strong mineral acid, sulphuric, for example, using 2 per cent. by volume, after which superphosphate or the like may be added, and the liquid clarified by settling, followed by filtration of the liquid portion and centrifugal treatment of the slime.

FILTRATION OF SUGAR JUICES. *Fritz Tiemann,* of Berlin-Wilmersdorf, Germany. *161,987* (*11,561*). April 21st, 1921.

The juice to be filtered is contained in the cylindrical vessel *F*; while the filtering material (the nature of which is not specified) arranged in a container *A* is moved up and down, leakage between this container and the walls of the cylinder being prevented in known manner, e.g., by means of a number of grooves with a suitable insertion of felt or hemp. The descent of the filter *A* is controlled by an hydraulic cylinder *B*, but any other mechanical device such as a worm drive, a screwed spindle, or the like is suitable for this purpose. The juice is admitted through openings *C* into the vessel *F* when the filter *A* is in its highest position, and the filter is then allowed to descend slowly through the stationary liquid. When granular materials not liable to form in layers are employed, the rate of fall is about 0·7 mm. per second. The rate of fall of the filter is exactly adjusted and controlled by allowing the water to flow from below the piston of the hydraulic lifting device *B*. At the end of the descent of the filter *A*, which, in dependence on the amount of the sediment, is somewhat above the base of the vessel *F*, the filtered juice standing over the filter is allowed to escape through an opening *D*, while the filter *A* is in its lowest position.



At the end of the filtration or extraction, after the opening *D* has been closed, the filter is raised by means of the hydraulic cylinder *B* at a high speed, for example 100 mm. per second, in order to cleanse the filtering material from the small impurities and sediment clinging to the lower part of the filter. On closing the lower opening *E*, any fluid in the filter material or water forced in is removed by the air which streams in at the upper part at a high velocity and passes through the filter to fill the vacuous space below the filter as the latter rises. During the further ascent of the filter *A* to its original position, the filter particles are completely dried by the air which is drawn in. The sediment is removed in a pulpy condition through the opening *E* in the base, whereupon, after this opening is closed, the filter is again ready for the operation to be repeated.

The filter can be cleansed from time to time by water admitted into the vessel *F* over the filter, which is raised through the water quickly by means of the hydraulic cylinder *B*.

MOTOR FUEL CONTAINING ALCOHOL. *J. M. A. Chevalier, P. Bourcet, and H. Regnault,* of Paris, France. *168,308* (*20,661*). August 3rd, 1921; convention date, August 27th, 1920; *not yet accepted;* abridged as open to inspection under Section 91 of the Act.

A liquid fuel is obtained by mixing alcohol with resin spirit, "essence of terebenthine," or other volatile liquid product of the distillation of pine resin or spruce. Acetone is preferably added with the resin spirit, and another terpene with the "essence of terebenthine." In an example, 1000 grms. alcohol, 200-600 grms. resin spirit of 0·890 specific gravity, and 125 grms. of acetone are mixed together.

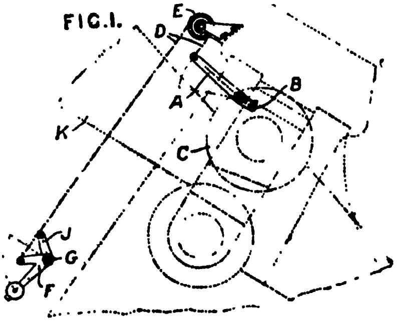
CATTLE FOOD CONTAINING MOLASSES. *H. M. Hardcastle,* of Manchester. *163,628* (*25,196*). September 1st, 1920.

A food for animals consists of hop meal and saccharine matter, preferably molasses, mixed with one or more of the following ingredients: barley meal, wheat meal, oat meal, rice meal, bean meal, pea meal, cotton cake meal, wheat sharps, wheat bran, maize meal, starch meal, ground cakes such as palm nut cakes, linseed cakes, and salt. (Specifications 14,124 of 1903 and 120,166 are referred to.)

MILL, PROVIDING MEANS FOR VARYING THE SPEED OF THE CONVEYOR FEEDING IT. *Chas. McNeil*, Colonial Iron Works, Glasgow. *170,211* (*32,780*). November 20th, 1920.

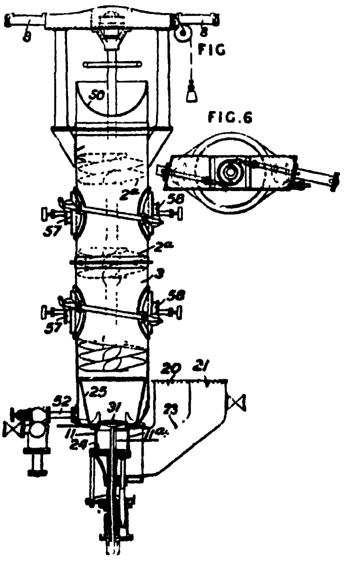
In a mill fed by a conveyor, variable-speed means are provided for driving the conveyor and for varying the speed of the conveyor in accordance with the movements of the movable roll of the pair of rolls fed by the conveyor. The housing, bearing, or other part moving with the movable roll is operatively connected through links and levers or equivalent mechanism with the means controlling the speed of the conveyor, so that as the movable roll moves away from the fixed roll the speed of the conveyor is reduced, and vice versa. The housing, etc., may be connected to the throttle valve of a steam engine, or to the controller of a variable-speed electric motor driving the conveyor, or to the speed-controlling gear of any form of variable-speed gear through which the conveyor is driven. As shown, a lever *A* is pivoted on the housing of the mill and the shorter arm is engaged by a pin *B* on the bearing-block of the upper and movable roll *C*, while the longer arm is connected to a chain *D* which passes over a pulley *E* and is connected to a weighted bell-crank lever *F*. A lever *J* on the shaft *G* of the lever *F* is connected to speed-varying mechanism controlling the speed of a conveyor which delivers the cane on to a shoot *K*. In a modification, the lever *A* is adjustably connected to a link secured to the lower lever *F*.

FIG.1.



EXTRACTION OF JUICE BY THE DIFFUSION PROCESS FROM BEETS, ETC. *Sir John Thornycroft*, of the Isle of Wight. *166,993* (*11,822*). April 28th, 1920.

A diffusion apparatus of the kind described in Specification *120,448*,[1] comprising a vertical column up which the material under treatment is forced against a descending stream of water, is provided with a screw *2a* to assist in raising the solid material. The screw may be continuous or interrupted, and either perforated or not, and it is rotated intermittingly by means of one or more hydraulic rams *8* acting through a ratchet gear as shown in Fig. 6. Sliced beet, etc., is admitted from a hopper *20* by a slide valve *11a* into a cylinder *11*, whence it is ejected by a piston *24* through a valve *31* into the diffuser *3*. Valves and piston may be hydraulically operated, and are so arranged that the introduction of a fresh charge into the diffuser is simultaneous with each rotation of the screw *2a*. The spent material is ejected from the shoot *50*, and the extracted juice passes through a strainer *25* to the outlet *52*. The slices may be saturated with juice passing through the perforations *23* from the vessel *21*. Transverse pipes and pumps *57*, *58* permit circulation of the liquid in the diffuser.



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[1] *I.S.J.*, 1919, 146.

CANE CUTTER.[1] *William Searby,* of Maui, Hawaii, T. H. *167,055* (*16,530*). June 18th, 1920.

CANE MILL COMBINED WITH TWO CRUSHERS.[2] *R. L. Goold,* of Birmingham (communicated by the *Fulton Iron Works Co.,* of St. Louis, Missouri, U.S.A.). *165,948* (*9723*). April 8th, 1920.

SEPARATING SOLIDS AND LIQUIDS BY CATAPHORESIS. *W. Acton and W. M. MacKean,* both of Paisley, Scotland. *169,315* (*19,134*). July 7th, 1920.

Cataphoresis is employed in connexion with a continuous vacuum filter for separating solids from liquids. A figure attached to this specification shows a rotary vacuum filter with the filter cloth supported on wire netting or perforated metal, which forms one of the poles, the other pole being a shoe, roller or slipper or an endless band moving over rollers. The drum is divided into segments and the liquid passes away through the spindle which is hollow. An example of the application of the process is the separation of maize starch from water.

CENTRIFUGAL MACHINES. (1) *R. A. Sturgeon,* of Chapeltown, Leeds. *164,867* (*8091*). March 18th, 1920. (2) *W. Cunningham,* of Moresby, near Whitehaven, Cumberland. *164,938* (*11,976*). April 30th, 1920.

(1) In a separating apparatus relative motion is obtained, for discharge purposes, between the chamber and its end wall by the variation of the pressure produced by centrifugal force in a liquid admitted to the space between the movable member and an end cover fixed to the shaft. (2) A discharge valve for a centrifugal driver is provided with a groove filled with jointing-material to form a liquid-tight joint with the casing. The valve is held down by a screwed collar.

CHOCOLATE MANUFACTURE[3] *F. G. Fryer; B. G. McLellan; and Rowntree & Co., Ltd.,* of York. (1) *165,840* (*18,512*); (2) *165,841* (*18,513*); (3) *165,842* (*18,514*); (4) *165,843* (*18,515*). July 25th, 1919.

(1) In the manufacture of high-class fondant chocolate, the cocoa liquor and sugar are mixed together after the solid particles have been reduced to a degree of fineness such that 98 per cent. can pass through a sieve, the holes of which are 53/1000ths. of a millimetre square. This eliminates the necessity of any grinding subsequent to mixing. Specifications 165,841 and 165,843 are referred to. (2) Relates to a process of mixing the finely divided cocoa and sugar constituents referred to in Specification 165,840. The ingredients are first mixed in any ordinary manner for about ten minutes. The mixture is then subjected to a high-speed liquefying operation and then the liquid is agitated at an extreme speed, preferably in a regulated current of air so as to produce a conched effect. The extreme agitation may be substituted by treatment in an ordinary conche. The process is a continuous one. (3) Consists in substituting the lengthy treatment of a fondant chocolate mixture in a conche by subjecting the mixture of cocoa sugar, etc., to a liquefying operation by means of a beater, and then to an extreme agitation or thrashing for a few minutes, preferably in a regulated current of air. (4) In the method described in Specification 165,840, in which all grinding is effected prior to mixture of the cocoa liquor and sugar, the ingredients are mixed and liquefied in a slow running machine such as an ordinary chocolate melangeur and are then subjected to an operation by which a "fondant" or conched effect is produced. The latter effect is produced by extreme agitation or thrashing for a short period, preferably in a regulated current of air, or by treatment in an ordinary conche.

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[1] See U.S. Patent, 1,348,751; *I.S.J.*, 1921, 59.

[2] See also U.S. Patent, 1,339,600; *I.S.J.*, 1920, 714.

[3] Also U.S. Patents 1,387,377—1,387,379.

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	One Month ending December 31st.		Twelve Months ending December 31st.	
	1920. Tons	1921. Tons.	1920. Tons.	1921. Tons.
Unrefined Sugars.				
Germany	7,097	....	12,929	....
Netherlands	..	....	....	398
Belgium	....	532	...	3,788
France	8	. ..	8	....
Austria-Hungary		....		....
Java	3,6[illegible]6	102	335,599	26,172
Philippine Islands	....	....	1	....
Cuba	10	41,467	516,487	256,798
Dutch Guiana	....	1,096	58	2,726
Hayti and San Domingo	....	....	13	82
Mexico	..	....	....	....
Peru	10,586	5,346	48,883	73,385
Brazil	4,675	11,831	12,439	79,964
Mauritius	17,040		139,193	184,748
British India	....	....	16,277	1,423
Straits Settlements	....	.	....	....
British West Indies, British Guiana & British Honduras	1,542	8,711	124,878	111,733
Other Countries	8,093	14,834	44,781	69,953
Total Raw Sugars	**132,718**	**83,918**	**1,251,546**	**811,170**
Refined Sugars.				
Russia	....	.	1	....
Germany	....	....	126	1
Netherlands	1	4,456	1,066	91,032
Belgium	10	6,667	2.068	42,979
France	..	....	294	3,058
Austria-Hungary	....		102	138
Java	2	....	5,014	4,339
United States of America	16	3,220	102,273	171,816
Argentine Republic	....	....	....	....
Mauritius		. ..	. .	....
Other Countries	62	14,979	8,867	154,981
Total Refined Sugars	**91**	**29,322**	**119,812**	**468,344**
Molasses	5,131	7,107	74,557	94,321
Total Imports	**137,940**	**120,347**	**1,445,915**	**1,373,835**

EXPORTS.

	Tons.	Tons.	Tons.	Tons.
British Refined Sugars.				
Denmark	....	..16	....	34
Netherlands	118	273	678	2,296
Portugal, Azores, and Madeira	....	...	....	....
Channel Islands	53	50	952	1,331
Canada	....	....	....	....
Other Countries	69	523	618	8,432
	240	862	2,248	7,093
Foreign & Colonial Sugars.				
Refined and Candy	6	338	6,437	801
Unrefined	51	343	9,929	3,310
Various Mixed in Bond	....	....	....	....
Molasses	275	483	3,740	1.032
Total Exports	**572**	**2,026**	**22,354**	**12,236**

Weights calculated to the nearest ton.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1921. Tons.	1920. Tons.
Total Receipts January 1st to December 28th	2,537,416	2,958,344
Deliveries ,, ,, ,,	2,548,468	2,951,727
Meltings by Refiners ,, ,, ,,	2,542,194	2,505,132
Exports of Refined ,, ,, ,,	373,000	325,000
Importers' Stocks, December 28th	none	7,888
Total Stocks, December 28th	35,131	61,776
	1920.	1919.
Total Consumption for twelve months	4,084,672	4.067.671

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1918-1919, 1919-1920, AND 1920-1921.

(Tons of 2,240 lbs.)	1918-19. Tons.	1919-20. Tons	1920-21. Tons.
Exports	3,538,536	3,251,271	2,104,224
Stocks	284,152	293,674	1,152,222
	3,822,688	3,544,945	3,256,446
Local Consumption	82,000	79,700	105,000
Receipts at Ports to October 31st	3,904,688	3,624,645	3,361,446

Havana, October 31st, 1921

J. GUMA.—L. MEJER.

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR TWELVE MONTHS ENDING DECEMBER 31ST, 1913, 1920, AND 1921.

	IMPORTS.			EXPORTS (Foreign).		
	1913. Tons.	1920. Tons.	1921. Tons.	1913. Tons.	1920. Tons.	1921. Tons.
Refined	922,545	119,812	468,344	760	6,437	801
Raw	1,046,715	1,251,546	811,170	3,889	9,929	3,310
Molasses	163,062	74,557	94,321	357	3,740	1,032
	2,132,322	1,445,915	1,373,835	5,006	20,106	5.143

	HOME CONSUMPTION.		
	1913. Tons.	1920. Tons.	1921. Tons.
Refined	899,327	139,622	469,473
Refined (in Bond) in the United Kingdom	715,661	785,140	787,572
Raw	116,942	181,240	131,881
Molasses	31.845	27,144	10,991
Molasses, manufactured (in Bond) in United Kingdom	37,587	67,927	47,539
Total	1,801,362	1,201,073	1,447,456
Less Exports of British Refined	23,271	2,248	7,093
	1,778,091	1,198,825	1,440,363

Sugar Market Report.

It is with deep regret that we have to announce the death of our partner—Mr. James J. Cherry—at his house at Anerley, on the 16th December last. He was associated with our firm for many years, and by his ever cheerful personality and untiring energy earned the affectionate esteem of his numerous friends in London, and other markets at home and abroad.

Our last report was dated 9th December, 1921.

The month under review marks the close of an eventful year in the history of the trade. Our market has passed through a period fraught with all the difficulties attending rehabilitation, at the same time having to contend against the reflex action of the trials of adjustment to new conditions in other parts of the world. The protracted decline in values which has brought raw sugar down to pre-war levels, has provided bitter experience for many whose enterprise in providing supplies for the trade was deserving of more favourable results. The unfortunate situation of Cuba, working upon her new crop, with an unsold stock of about a million tons of old sugar, is still the feature which holds the attention of American and British refiners, who, whilst contesting for the trade on this side, keep a watchful eye upon this plentiful supply of raw material. Dealers and manufacturers in their turn are rendered increasingly cautious by the position, with the result that invisible stocks are practically non-existent. There would seem to be good reason for regarding present prices as moderate, and capable of some reaction upon the revival of demand.

The meltings by U.K. refiners for 1921 are said to have been 950,000 tons as against 937,000 tons and 1,043,000 tons respectively in the two previous years.

Trade has been poor during the past month, and prices have been further forced down by the competition between American Granulated and British Refined. Tates' London Granulated at 46s. prompt is 2s. 9d. per cwt. down on the month; February/March is quoted 44s. 6d., April/June, 45s.; No. 1 Cubes at 51s. are 3s. 6d. per cwt. lower. American Granulated afloat is offered at 17s. 6d., first-half January 17s. 4½d., January/March 17s. c.i.f.; Czecho-Slovak Cubes, ASP, etc., are quoted at 21s. f.o.b. Hamburg ready; Superior Granulated, SCH, TTD, A, etc., is not offering in first hands, but second-hand lots ready are obtainable at 17s. 6d. f.o.b. with very few buyers. Belgian Crystals ready 17s. 3d. sellers, spot done at 42s. 6d. White Javas spot London are doing at 42s. 9d.

White Sugar in the terminal market is steadier in tendency, sellers showing more reserve at the low level reached. After being done down to 16s. 7½d. May and 16s. 9d. August, there are now buyers at 17s. 1½d. for May, whilst August values 17s. 3d. The raw terminal market is neglected and quotations are more or less nominal.

The Mauritius market is nominal, shippers being engaged with the despatch of quantities contracted. Mail advices from the island put the freight engagements for December at about 11,500 tons for Bombay and 42,000 tons for U.K., but it is since reported that one cargo for U.K. has been diverted eastwards.

Latest reports of sales of Centrifugals from Cuba include 15,000 bags old crop at 1⅞c. c. & f. New York, and some 30,000 bags for shipment to the U.K. at 10s. 6d. per cwt. c.i f. Conflicting rumours have been current of arrangements made by the American refiners for taking old crop sugars on a "toll" basis, but it seems to be correct that about 250,000 tons have been earmarked in this way by treaty with private holders in Cuba

New crop Java Whites have declined in value under offerings by second-hand holders, and down to 10¼ g. first cost was done. Bids of 10 g. made to the Trust were refused, but it is now reported that the Trust have sold at 10⅜ g. first cost. The quantities of old crop left for sale are so comparatively small as to cause no pressure. The quotation of 12½ g. f.o.b. for January/March works out at about 19s. 9d. c. & f. Calcutta, a price which is unobtainable in face of the ample stocks in India and the consequent resales by holders. Recently such resales have been effected at 18s. 3d. January, and 18s. 10½d. March c. & f. Calcutta. It is estimated that the next Java crop will approximate 1,650,000 tons, of which about 870,000 tons is expected to be in the form of Whites and 760,000 tons Browns and Muscovados.

H. H. Hancock & Co.

10 & 11, Mincing Lane,
London, E.C. 3,
January 7th, 1922.

THE

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Notes and Comments.

The Need for More Intensive Cultivation.

The Report of the Committee in charge of the Experiment Station of the Hawaiian Sugar Planters' Association for the year ending September 30th, 1921, to which we refer on another page, will, we expect, attract a good deal of attention, if indeed it does not become somewhat of a classic in these latter day developments of the sugar industry. In our review of the report of two years ago,[1] we gave a short epitome of the stages of development of the industry since its modest commencement in the eighties, and this may be referred to by those not conversant with the special conditions prevailing. The problems set before the planters were in many respects unique and were approached by unusual methods. The natural resources of the group of islands were so great that, once a settled government made the investment of capital possible, it was seen to be an economic proposition to expend far larger sums of money on their exploitation than in any other country. And it was pointed out that the surprisingly rapid results obtained in the cane fields were largely due to a fine spirit of co-operation among the planters themselves who, without the aid of the Government, appointed their own scientific assistants and conducted their own experiments. In this respect we can compare Hawaii with Java, whose complicated machinery of co-operation among the planters, detailed in a recent number,[2] has placed it in the forefront among sugar producing countries. And, although the conditions obtaining are as divergent from those in the Hawaiian islands as it is well possible for them to be, the result has been the same both in scientific achievement and in commercial success. In both cases money is very freely spent on useful experiments, and there is no talk of cutting down any work that the planters consider to be in the interests of the industry. The amount of money spent on scientific and economic work and the splendid work results obtained are unique in these two countries. The various governments of sugar cane countries, with many other calls on their resources, are devoting large sums of money to the development of their major industries, that of sugar production included, and the efforts of their scientific officers are only too often subjected to a good deal of ungenerous criticism. In view of these facts, one may be permitted to surmise that it might be in the best interests of the industry in all important sugar producing countries in the tropics, if the government should withdraw its assistance entirely and leave the planters to work out their own salvation! The introduction of small levies for such work has, we are aware, been entered on in a tentative manner in several directions recently; and this is a move in the right direction. But a much more complete pooling of interests among the planters is, we are convinced, needed before the best results can be obtained.

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[1] *I.S.J.*, 1920, pp. 136–140.

[2] *I.S.J.*, 1921, pp. 493-498.

We may also draw attention to another feature of the report, namely, the dominant position of plantation as against factory work. We have on several occasions emphasized the importance of more intensive methods in the plantations. In most countries the factory equipment and practice has reached a high degree of excellence and, while carefully guarding against any falling off in this respect, it is now perhaps of more importance to the industry to see that the factory is fed with a sufficiency of the best material in the most economical way. This can only be brought about by intensive research by competent scientific men in the field. The Hawaiian planters appear to have fully realized this point of view, and their annual report offers a useful example of the extent to which this should be done and the manner of carrying it out.

Further Preference desired for British Sugar.

In the old days the British West Indian sugar industry had a legitimate grievance against the bounty-aided competition of German beet sugar. This was eventually remedied; but now even with an Imperial preference of 16⅔ per cent. to help them against foreign sugars in this country, they are in low water again because Cuba is selling sugar below cost price owing to the force of circumstances, and the result is a low world's price for sugar much below the normal cost of production.

In the ordinary course of affairs the natural thing to do would be to shoulder their losses and hope for better prices next season. Unfortunately this policy requires reserves of capital which the West Indies seemingly do not possess; at any rate, the planting community in the British islands have decided to send a deputation to England to ask for a larger preference to tide them over the present abnormal conditions.

This same ruling low price of sugar is also responsible for difficulties in the two beet sugar factories working in England—Cantley and Kelham. The former has had a successful season on the whole and would have done all right, we understand, were sugar at a more normal figure. But not only is sugar too cheap but there is no great demand at the moment for it, so neither Cantley nor Kelham are able to dispose of their production without first warehousing it, a procedure that naturally increases the cost. Kelham is of course overcapitalized and was unlucky enough to place contracts with its farmers at an impossibly high figure in the light of the subsequent fall in the sugar market. So there is no question here of anything but a heavy loss on the first year's working. Cantley has sliced about 45,000 tons of roots coming from Norfolk, Suffolk and Cambridge, but the phenomenal drought affected the sugar content of the roots, which was disappointing. All the same the campaign has been sufficiently encouraging on the agricultural side to make it desirable that it should not be dropped owing to the manufacturing side being uneconomical. In view of this, it is said that a joint attempt is being made to induce the Government to reduce the excise duty to a minimum to assist the industry to tide over the period of low prices and depression.

Since the excise is nearly £20 per ton, the benefit that would accrue from its temporary suspension would be considerable. On the other hand the industry is so small that very little difference would result to the Exchequer. Since the Government are heavily committed in the case of Kelham, they have some grounds for giving the appeal a careful consideration.

How far the Government will be disposed to give an ear to the pleas of the West Indian deputation is another matter. As has been rightly pointed out in detail to the colonists by the *West India Committee Circular*, this country is about the most heavily taxed nation at the present day, and cannot lightly forego a convenient revenue such as it gets from sugar. The Government have at all events—if the Under-Secretary for the Colonies is to be believed—resolved at the least to guarantee to the British Empire the Preference on sugar of one-sixth the import duty for ten years to come. But if the sugar duty is reduced, so is the amount of the Preference.

We said last month that we thought the sugar duty was really too high in that it was stifling consumption. On the other hand, the Exchequer undoubtedly considers it a valuable source of indirect taxation. But in view of the present abnormal state of the sugar market, the Government might do worse than increase temporarily the Imperial Preference as well as reduce the Excise at home. Neither step would make much difference to the income of the Exchequer, nor do we suppose it would make sugar cheaper to the public, but it would tend to preserve some very useful sources of supply which all play their part however small in preventing a monopoly in the sugar market. We are far too dependent on Cuba and Java as two sources of supply. It is in our interest to extend and preserve other sources, preferably in the British Empire, and desperate diseases call for like remedies. So whether the Government reduce the sugar duty as a whole or do not, they should keep the Imperial Preference idea well in view. After all Cuba, a mostly independent country, gets 20 per cent. preference for her sugars entering the U.S. market.

The American Consumption during 1921.

The American consumption of sugar during 1921 in the Continental United States amounted to 4,107,328 long tons (refined or consumption value), which was a slight increase (0·555 per cent.) over the total for 1920. The consumption per head amounted to 84·47 lbs., as compared with 86·56 lbs. the previous year. According to a recapitulation of WILLETT & GRAY, this total was provided from the following sources: Louisiana and Texas (cane) 272,773 tons; U.S. beet 946,977 tons; Hawaii (cane) 482,322 tons; Virgin Islands (cane) 5170 tons; Porto Rico (cane) 373,762 tons; Philippines (cane) 131,168 tons; various domestic 2274 tons; Cuba (cane) 1,866,153 tons; Foreign Raw Cane 20,311 tons; and Foreign Refined Cane 6418 tons. Falling prices almost throughout the entire year led to a great lack of confidence on the part of the buying public and while prices were much lower than in 1920 and were consequently a factor for increased consumption and for the filling up of invisible stocks that had been greatly depleted, yet the continuation of the decline was a deterring element which prevented the consumption being larger than the figures show.

Prospects of Production and Consumption in 1922.

Lately various American interests have, as is their custom at the New Year, been engaged on the attempt to forecast the prospects of the sugar industry for the coming year. These forecasts are not always free from the suspicion of an attempt to buoy up the market, but the probable facts are worth studying even if opinions differ as to the conclusions to be drawn from them. The following comments on the situation have been published in America by Mr. MANUEL E. RIONDA, Vice-President of the Czarnikow-Rionda Company.

"With the return of a free market there is, however, no reason for pessimism as to the future. Sugar has seen its worst, and the outlook is brighter than it has been for some time. The return to individual control in Cuba will, in my judgment, exert a certain tonic effect on the various factors of the Cuban sugar industry. The premium placed on individual initiative will be an incentive to a determined effort to lift the production of sugar to a more efficient and economical level than ever before, and the best brains of the Cuban sugar industry will redouble their efforts to instil new life and vigour into the industry.

"It would be impossible to overestimate the importance of the tariff legislation which is now pending. The present temporary level of 1·60 cents, after the deduction of the 20 per cent. differential on Cuban sugars, is very hurtful. At present price levels it involves an *ad valorum* duty approaching 100 per cent. It is a hopeful sign, however, that it seems more and more to be realized that there is nothing necessarily antagonistic in the interests of the sugar industry of this country and Cuba, and that it is possible to arrange to meet the sugar requirements of the United States from these two sources of supply without subjecting both to the results of constant bickering and acrimony. Cuba fully understands that its market in the United States is, under present consumption, limited to about 2,500,000 tons, which is the margin which American producers, both domestic and insular, cannot supply. Cuba is quite confident of her ability advantageously to dispose of the remainder of her crop to the rest of the world. It must be remembered that the market for Cuban sugar is world-wide. For instance, Japan and China are showing considerable interest in Cuban sugar, recently recorded purchases by these countries being the forerunner, it is believed, of more to follow, as a result of present low price levels.

"As far as the American situation is concerned, I feel that the low price of sugar—much below cost of production—cannot fail to exert the usual effect of increasing consumtion and decreasing production, and the estimated 1922 consumption of 4,500,000 tons seems a conservative one when compared with a little less than 4,100,000 tons consumed in 1920, when the situation was so chaotic and sugar was abnormally high for a considerable period.

"England has little or no sugar at the present time, and normally that country consumes 136,000 tons a month. England is importing sugar at the present time, and deliveries of Cuban sugar are arriving steadily. Continental sugars have not been offered freely, owing to brisk demand on the Continent itself. All over Europe war-time restrictions are lifting. For instance, in Czecho-Slovakia to-day anyone may purchase unrestricted quantities of sugar for local consumption, whereas consumption was heretofore restricted to a small amount stipulated by sugar ration cards. Throughout Europe, manufacturers, many of whom were on very short rations, are now accumulating reserve stocks. In France, the drought, following by early frosts which caught a considerable portion of the beet crop in the soil or on the ground awaiting shipment, will result in a production inadequate for French requirements, so that France will in all likelihood be a heavy buyer in the international field during next year. Take the case of Germany. Though the 1921-22 crop is nearly ended, deliveries are not being made fast enough to satisfy consumers, and the idea is prevalent that the Government will allow free imports of raw sugar for the sake of re-exporting in the shape of marmalades, chocolates, etc.

"Conditions abroad are in a happier state than at any time since the great cataclysm and its aftermath. The results of the disarmament conference, the fact that the Irish question will soon be determined, as well as that the problems involved in Germany's reparation payments are also in a fair way to being solved, are all distinctly hopeful influences. Some form of international conference for the discussion of world-wide financial conditions will undoubtedly take place, and that is another portent, as encouraging for foreign trade in sugar as it is for all other commodities.

"Considered in connexion with the improvement of business conditions in this country,—slow to be sure, but on a sound basis fundamentally,—we have a situation which offers much general encouragement as we enter the year 1922."

On the other hand, Messrs. **Smith & Schipper**, of New York, in their well-known and influencial market report, the *Federal Reporter*, take a less rosy view, inasmuch as they point out that while the carry-over from 1921 in the United States and Cuba is nearly two million tons, indications point in their view to the carry-over a year hence being as much as 1,443,000 tons. If that figure turns out to be anywhere near the actual one, it proves that consumption is not going to overtake production for another 18 months at least. All the same, while it is easy to forecast the probable consumption in 1922 of the New World, that of the Eastern Hemisphere is wilder guesswork, and there are so many factors at present in a nebulous state which may in the end affect this year's consumption of Europe, that the actual absorption of the available supplies of sugar this year remains a very speculative matter.

Refining Cuban Sugar under Toll in New York.

One atttempt on the part of Cuban-American interests to get rid of some of the Cuban sugar surplus has been an arrangement come to by two American refining firms, the American and the National, to refine under toll 250,000 tons of Cuban raws during the first eight months of this year. The whole product will be exported and obviously at a price that will compete severely with the output of British and European refineries. The producing companies of the raws (who we take it are left with the risk of selling the finished product) are said to be the Cuban-American, the Cuba Cane, the Howell, and the Rionda, interests, as well as several banking concerns. According to **Lamborn**, the tolling margin is 90 points and 93 lbs. of refined will be delivered for 100 lbs. of raws basis 96°. It is said that the price at which the raws will be consigned to the refiners is 1¾ cents c. & f. With the refining cost fixed at 0·9 cents per lb., it is not surprising to learn that some of these sugars have been sold first hand in New York f.o.b. for 3·10 cents per lb. or round about 16s. per cwt.

Beet *v.* Cane in the U.S.A.

The old battle between cane and beet interests in the United States seems to have been renewed lately with some virulence. The beet interests have told the Senate Finance Committee which is considering the question of the continuation of the emergency tariff on sugar that they are in a deplorable financial condition and will in many cases be forced into bankruptcy if no relief is given them in the form of increased protection. It is suggested, however, that their losses are due to the enormous depreciation in their capital values and that in past years they have paid away too great a sum in dividends. Be this as it may, it is evident that the beet companies are only suffering like other concerns, and every one of the latter could doubtless advance an equally good reason for claiming increased protection for the time being from the slump in trade. Mr. E. F. **Atkins**, a well-known American sugar authority, considers that the low ebb in which the sugar industry now finds itself will check itself if not interfered with by the Government, through exhaustion of resources, both cash and credits; if artificially checked, the result would in his opinion merely be to encourage all, upon a higher market, to produce beyond requirements.

Messrs. **Willett & Gray** in their *Sugar Trade Journal* point out pertinently enough that while Cuba and the beet industry are thus arguing their different view-points, and contending for different results, the one for increased tariff rates and the others for reduced tariffs, the consumer apparently is not being considered. They think the present duty too high as a permanent feature.

"With the present tariff on raw sugar at 1·60 cents per lb. for 96° test Cubas, the rate is close to 100 per cent., which is too high for a commodity as largely used as sugar and really puts it in the luxury class as far as the percentage of duty is concerned. Just because the price of sugar is comparatively low there is no just reason for assessing a tax of nearly 100 per cent. on same. If this theory applied to all other commodities Congress would be swamped with protests. It might reasonably be stated that an emergency still exists in the domestic beet industry, and hence a continuation of the present Emergency duty of 1·60 cents might be kept in force for the balance of this year. For 1923 a reduction of 1·25 cents on Cubas and for 1924 the old tariff rate of 1 cent a pound on Cubas would be a fair compromise and would include some consideration of the consumer as well as the manufacturing end of the trade and hence should satisfy everybody. The beet industry made its greatest progress under tariffs on sugar not exceeding 1·348 cents and 1 cent per pound, showing that the present high rate of 1·60 cents is not needed except during some emergency period."

Dividends of Sugar Interests.

The bad state of trade during 1921 is reflected generally in the annual reports of most sugar firms which have been announced the last two months. TATE & LYLE, LTD., who have averaged 23¾ per cent. the last ten years recommended in December a dividend—interim by the way—of but 7½ per cent., and the chairman hinted that the shareholders must not count on a final dividend being paid. The fact that they have to meet the competition of the refined-on-toll sugars from New York will doubtless restrict profits in the immediate future. The Cuban unsold surplus is of course the dominating factor in keeping the market depressed and the bottom limit of prices is not yet reached in all probability.

The St. Madeleine report to June 30th last revealed a heavy loss on the year's working, the net deficit being £95,228. In order to finance the Company's operations during 1921-22, the Board is creating £200,000 10 per cent. debentures, redeemable at 110, of which they have allocated £100,000 to Company's bankers as collateral security for advances, and £50,000 were issued to subscribers for cash at par. The cost of production for 1921-22 will show a large reduction. Wages have fallen to a reasonable level, and labourers are working better. Prices of fuel, bags, engineering and other stores are also much lower, and the Trinidad Government has announced that the agricultural, immigration, and produce taxes, which cost the Company £18,800 in the past year, will not be imposed on the 1922 crop.

On the other hand, the East African sugar estates on Portuguese territory have not done badly. The Incomati Estates, although the slump in sugar prices is making a difference to them of £100,000 on the 1921 crop, expect to make more than £10 per ton of sugar made. The Company propose eventually to dispose of their Mauritius assets and remove the machinery and plant to Incomati, where they expect gradually to develop their output till it may reach 18,000 tons per season. Further, money is to be raised to purchase new plant. The Sena Sugar Estates have just paid 14 per cent. for the year, while £174,441 has been carried forward subject to E.P.D. and corporation profits tax.

The report of the Cuban-American is typical of Cuban losses, but they have come out of it exceptionally well as compared with the majority of Cuban concerns. For the year ended September 30th last they had a net loss of $7,896,730. But thanks to strong reserves they were able to pay 25 per cent. on the common stock, 7 per cent. on the preferred stock and carry forward $18,982,468. It is, all the same, a big change from the $12,117,200 profit of the previous year.

Agriculture in Jamaica during 1920.

The Jamaica Department of Agriculture Report for the year 1920 (compiled by Mr. H. H. Cousins) states that that year was to the agriculturists of the island one of the most extraordinary in the history of Jamaica. The average rainfall was the lowest recorded for the past 48 years and yet, so great are the variations in conditions in this colony, the sugar areas at the western end of the island suffered from excessive rain to such an extent as seriously to hamper the manufacture of sugar. Over other large areas, however, severe conditions of drought were experienced. For an agricultural country the year 1920 may be regarded as having been a very bad one indeed for Jamaica. Had production been favourable the planters would have secured returns previously undreamt of. Sugar, rum, and an array of other products all sold at high prices, and every class of the agricultural community shared in the general prosperity.

But, as Mr. Cousins remarks, it is a somewhat melancholy task to have to review this brief period of inflated values at a moment when a depression even more unprecedented than the previous year's inflation was paralysing the markets of the world and casting its shadow over the industrial life of Jamaica.

The sugar industry suffered somewhat severely from the drought of 1920 and exports did not exceed 37,000 tons, which was a good deal below the original estimate for the crop and less than that exported in the previous year despite a large increase in cultivation and in factory capacity. So great was the world demand for sugar, however, that even crude sugar produced in open pans by small settlers was called for, and quite an appreciable export of small settlers' produce resulted. The crop after providing for the needs of the local consumption brought in three million pounds sterling, while 7400 puncheons of rum were exported to the value of £290,000.

The capacity of the factories now in existence, or in process of erection, is sufficient to maintain an export of about 60,000 tons of sugar and, given a market from which fairly remunerative prices for sugar may be obtained, Jamaica should in future contribute to this extent to the supplies of sugar for the British Empire.

International Exhibition at Rio de Janeiro.

An International Exhibition (to celebrate the centenary of Brazilian independence) is being held in Rio de Janeiro from September to December next, at which a British section will be organized. In view of the intention of other countries to participate widely in this display, it is essential that the British section should be thoroughly representative. As the Department of Overseas Trade points out, there can be no doubt that the Brazilian people are strongly predisposed in favour of British firms and British goods, the reputation of both standing even higher than before by reason of the contrast with the quality of the goods and the methods of other nations who took advantage of the war to exploit the Brazilian market. An indication of this strong pro-British sentiment may be found in the fact that although financial stringency prevents the United Kingdom from participating on such a lavish scale as certain other nations, it has nevertheless been allotted the best site in the whole exhibition area. A Committee has been formed to co-operate with the Department of Overseas Trade and has collected funds which will defray nearly half of the cost of the British section.

It is to be hoped that British makers of sugar machinery and apparatus will be found represented at this Exhibition. Full particulars regarding rates for space, etc., can be obtained from the Department of Overseas Trade, London.

American Sugar Supplies in 1922.

A New York Expert's Forecast.

We take the following interesting forecast of the supplies of sugar likely to be available during 1922 from *The Federal Reporter* of January 12th, (published by Smith & Schipper, 91, Wall Street, New York.)

A feature of the week was the statement by Secretary Hoover, through the Department of Commerce, which was given wide publicity and which naturally caused some interest to attempt to "bull" the market and encourage speculation. The effect of a rising market at this time is bound to act as a stimulant to production in Cuba, Europe and elsewhere, and together with the carry-over on January 1st, 1922, of 2,000,000 tons (refined sugar basis) will make for a reaction later on. As premature "bullish" movements have so often worked to the disadvantage of producers and the trade in general, we take this opportunity to present to our readers the following analysis of available supplies for 1922. The Secretary's remarks that the world's production of sugar in 1922 is estimated to be from 400,000 to 800,000 tons less than in 1921 should have been coupled with a statement to the effect that the carry-over into 1922 from 1921 into the United States and Cuba is close to 2,000,000 tons (refined sugar basis), made up as follows (figures in tons of 2240 lbs.) :—

	Tons.	Tons.
Cuban raws	1,160,000	
Hawaiian raws	20,000	
Afloat to ports north Hatteras	60,000	
Refiners' stocks of raws	60,000	
Unsold portion Louisiana crop	100,000	
Total	1,400,000	
Equal in refined sugar to		1,300,000
Refiners' stocks of refined sugar and carry-over of domestic beet sugar		700,000
Total carry-over, January 1st, 1922 (refined sugar basis)		2,000,000

This carry-over is at least 1,250,000 tons above normal, and in any event fully offsets possible decreases in production.

In addition to the above carry-over, the following New Crops are estimated to be available :—

Cuba	3,500,000	
Porto Rico	400,000	
Hawaii	450,000	
Virgin Islands	5,000	
U.S. receipts, Philippines	150,000	
U.S. receipts, outside sugars	100,000	
Total	4,605,000	
Equal in refined to		4,283,000
Total supplies available up to October 1st, 1922		6,283,000
Allowing for exports during 1922 from Cuba and the U.S. to foreign countries (refined sugar basis) a total of	1,250,000	
And consumption in the U.S. from Jan. 1st to Sept. 30th, at the rate of 360,000 tons (refined sugar basis) per month	3,240,000	
We obtain a total of		4,490,000
Leaving a balance on October 1st, 1922, of		1,793,000

We then would have coming on the market the New Domestic Beet and Cane Sugar crops, which during the past campaign totalled over 1,100,000 tons, but to be conservative we estimate this at 20 per cent. less for 1922-23.	880,000
Which together with the estimated carry-over on October 1st, makes a total available from that period on of	2,673,000
From which must be deducted consumption during October-December which if taken at a monthly average of 360,000 tons (refined sugar basis) amounts to	1,080,000
Balance	1,593,000
Less Cuban local consumption	150,000
Leaving a carry-over on January 1st, 1923, of	1,443,000

During the campaign of 1919-20 the European beet crop totalled 2,594,000 tons, and in the year 1920 Cuba and the United States exported to foreign countries 1,285,000 tons. In the campaign of 1920-21 Europe produced 3,719,000 tons, an increase over the previous period of 1,125,000 tons, and Cuba and the United States exported to foreign countries in 1921 935,000 tons, a decrease of 350,000 tons when compared with 1920. The European beet crop of 1921-22 is estimated at 3,974,500 tons, or 255,500 tons greater than the 1920-21 crop, while we have allowed in the above table for exports from the United States and Cuba to foreign countries during 1922 a total of 1,250,000 tons (refined sugar basis), or 315,000 tons more than in 1921.

Of course, the carry-over of 1,443,000 tons in the United States and Cuba will depend on the latter making a crop of 3,500,000 tons, but on the other hand if this figure is not reached increased values may result which, in our opinion, will make it difficult to export to foreign countries from Cuba and the United States the figure which we have estimated, viz.: 1,250,000 tons. Then if consumption in this country be increased above our figure of 4,320,000 tons (refined sugar basis), the carry-over will be reduced by the amount of the increase. Already invisible supplies are being in part replenished, as will be seen from the following table showing U.S. refiners' meltings for domestic consumption for the period September 29th to December 28th inclusive, in tons of 2240 lbs.:—

1921, 723,353 .... 1920, 552,605 .... 1919, 449,956

These figures show that for the period under review 170,748 tons were distributed in 1921 in excess of 1920, and 273,398 tons more than in 1919.

It is pointed out that the Government of India have established at Pusa a sugar bureau with the object of furnishing advice to cultivators, manufacturers, and others. This has collected a mass of valuable information with regard to the sugar industry. British makers of sugar machinery, if they have not already done so, should place themselves in communication with the secretary, Indian Sugar Bureau, Pusa, Bihar, India.

Carob pods, which contain about 40 per cent. of total sugar, are being used for the production of alcohol in Catania, Sicily, where a distillery using about 40,000 kg. daily is in operation.[1] After crushing the pods without breaking the seeds (which are exported to England as locust beans), extraction is effected in open diffusion battery, and the juice is fermented by pure cultures of special yeasts. By employing two yeasts symbiotically, the optimum temperatures of which are 30° and 37°C., highly concentrated worts can be fermented. A yield of 22–24 litres per 100 kg. of carobs is obtained, while the exhausted residue is dried and used as fuel.

[1] J. Mezzadroli. *Bull. Assoc. Chim. Sucr. Dist*, 1921, **38**, 510–517.

Experimental Work in the Hawaiian Islands.[1]

The key notes of the Annual Report of the Experiment Station in these islands are an acceptance of the fact that the sugar industry is undergoing a serious crisis and a restrained optimism as to their ability of meeting the emergency. Every aspect of the problem of increasing the outturn of sugar per acre and making the most economic use of the available man-power is being carefully examined. This does not connote any limitation of the scope of the scheme of experimental work laid down, but rather the reverse. "More investigation, more experimentation, more research, leading to higher yields per acre and lower costs per ton" are the words in which H. P. AGEE, the director, sums up his programme. A table is given of the annual cost of the station since its start in 1895, from which it is seen that the money spent arose from a modest $7000 in that year to the respectable sum of $226,190 in the year under report. This leaves out of account various other outlays, such as that in cane raising on the new Waipio sub-station for distribution to the planters, as there is a substantial profit on this. But there is no suggestion of any demurring at this great amount of money being locked up; all the old lines of research are being continued and several new ones of great importance are being rapidly opened up, where there appear to be reasonable prospects of getting more sugar out of the ground by the application of intensive methods. Perhaps the most important lines are the following: a great increase in well-trained supervising staff on the plantations and the means of training it, the improvement of the stand of canes by a new intensive method of "bud-selection" on an estate scale, the prosecution of experiments in superintensive sugar production with a study of the relative proportions of the use of man-power in all the field operations, the development of a wide scheme for the reforestation of the denuded watersheds in order to conserve and increase the water available for irrigation, and an increased attention to soil analyses with a serious attempt to correlate the results in field and laboratory. Accompanying these major projects, is increasing activity in the botanical, entomological, and mycological studies of the sugar cane, while the factory inspections, compilation of mill data, clarification studies and other work in the factory are not being neglected. We have frequently urged that more attention should be paid to actual work in the fields and that increased production is the need of the present day cane industry, and this point of view is obviously dominating the work in the Hawaiian Islands.

Superintensive cultivation.—Mr. AGEE points out that for unavoidable reasons (largely labour changes) the average production is if anything showing signs of decreasing, and suggests that it may be found economical to reduce the area cultivated for several years while by the application of more intensive methods raising the average output so that the total production will be maintained. This he shows to be quite possible from his experiments during the past few years. In these he obtained during the last two years an average of 12 tons of sugar per acre, and 17 acres of his area gave as much as 15·8 tons. The main points held in view were the following: an extraordinarily close supervision of every acre grown, a careful decision as to the correct moment when to cease irrigation for ripening off the canes, and a study of the man-days required per acre and per ton of sugar produced both as day work and by the fore-time contract method. In a table he gives details of the gradual increase in production. In 1914-16 the average was

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[1] Report of the Committee in charge of the Experiment Station, Hawaiian Sugar Planters' Association, for 16 years ending 30th September, 1921. Honolulu, 1921.

8·04 tons in the two-year period and in 1917-19 8·32 tons. In the early years inferior varieties were used, damage was also done by Anomala and root disease; there was further a lack of knowledge as to the profitable limit and time of application of the manures. These difficulties being removed, greatly increased yields of cane were obtained but the juice was poor. There would thus appear to be some correlation between heavy yield and poor juice, but tests as to the proper time of stopping irrigation for ripening the cane proved this to be an error. This is seen in the average yields in the table for 1920-21 when 12·08 tons of sugar were obtained. These figures have tempted him to draw some conclusions. If, he remarks, an additional ton of sugar could be obtained per acre this would allow for the employment of one expert supervisor for every 200 acres of cane; if on the other hand two tons were added the profit would be, at $50 per ton, $30,000 for every 300 acres, a very inviting proposition. On reviewing the average man-days employed over the territory for each operation in the field both for irrigated and unirrigated lands, the biggest chance of reduction is undoubtedly under the cultivation and irrigation heads, and this is just where the expert supervisor would come in; so also with regard to the proper manipulation of cane collecting and hauling by the new devices, and especially in the enormous draft of labour required for weeding after heavy rains. On the face of it, a good case is made out for the general application of the superintensive method of cultivation.

The improvement of cane by bud-selection.—This again is a new line of work. We refrain from commenting on it from the scientific point of view and merely give what scanty references are available. Details of the progress of the work have been given by SHAMEL and MOIR in the August and October numbers of the *Record*, respectively, and some quotations are given in the report before us. In the first we read "The parent stools having uniformly good stalks, selected and planted in 1920, produced uniformly good progenies in 1921 while the poor parent stools produced uniformly poor progenies. The parent stools having some good and some poor stalks produced some good and some poor stools." Although SHAMEL considers it too early to estimate the amount of gain in sugar per acre, he regards it as safe to put it down at 25 per cent. The second paper gives further details obtained in 1921 on the Papaikou test area, showing the striking increase of selected cane over the unselected. This is seen in the following table:—

	INCREASE (UNSELECTED = 100 per cent.)		
	Stalks per Seed Piece. Per cent.	Stalks per Foot of Row. Per cent.	Tons Cane per Acre Per cent.
68 selected progenies..	162	129	130
22 best selected progenies	202	169	157
3 very best selected progenies	228	189	184

Besides this, there was an actual gain of 20 per cent. in the quantity of seed used and gains in other directions were also noted. "Some progenies that have been obtained will yield as much in one year as the plantation fields will average in two, and others have been kept for study that were so inferior that one had difficulty in obtaining seed to continue the progeny through another crop." MOIR asks whether this fact alone does not demonstrate the importance and necessity of selection to maintain high yields. Different strains have been isolated that are so distinctly superior that they stand out like new varieties; but this class of work requires special aptitude and the closest study for the best results to be obtained. It is obvious that little advantage would be gained by its being taken up by untrained men, not capable at a glance to detect the kind of differences which will be of use in the cane clumps. There are many minor points that will crop up which without a thorough morphological knowledge of the cane plant might lead into serious error and greatly delay the work. AGEE states that a plan has been inaugurated by which the work will be extended to every plantation on the islands during the next twelve months, and with the co-operation of the planters all the cane planted will by 1924 be obtainable from selected nurseries.

Soil investigations.—The department was better equipped during the year under report for this class of work by the addition of an officer with much experience in soil analyses and research, and a considerable impulse has accordingly been given to these investigations. There are two main lines of enquiry, namely, problems on individual plantations and research work to gain information regarding the soils of the Territory and their relation to intensive one-crop cultivation. The former is illustrated by examples drawn from four different plantations. In one case the collation of all previous analyses done by the local and station chemists and a few additional ones gave what was practically a soil survey of the whole plantation. It is not possible for the department to do much in this line, but they are always ready to assist in such investigations as will throw light on the correlation between laboratory analyses and field results. In a second case the soils showed a rather marked deficiency in potash and phosphates, but this was not considered in itself sufficient to account for the poor yields obtained. These poor results were chiefly obtained on "mauka" lands (recently brought under cultivation and formerly under forest?), and it is pointed out that any physical defect such as would occur on such lands would be likely to emphasize any paucity of the necessary plant food. In the third and fourth cases, where the main manuring had been nitrogenous for several years, the fields with poor yields were analysed for potash and phosphates, but as these were found in sufficient proportions it was concluded that the fault did not lie with any deficiency in these plant foods.

The research work is of more general interest. At present there is insufficient information both as to the changes taking place in plant food where sugar cane has been grown for a number of years and of the fluctuations in the amount of available plant food during different times of the year as the result of the ordinary operations of ploughing, cultivating and so on. The phosphatic contents of the soil are receiving special attention from these points of view, and it has been already determined that in the islands this usually occurs combined with iron and aluminium. Two special cases of gain and no gain after the application of phosphates have been selected for intensive study, special plots being analysed every two months as to the changes taking place in the relative amounts of nitrogen, calcium, potassium and phosphorus. Much information is being obtained regarding the last mentioned, and the results will be published at the end of the year.

Another allied investigation is the *conservation of organic material* in the soil. Cases have been met with where the addition of the trash has met with no response and it is mentioned that on the mainland, where the trash has not been properly rotted, a diminution of nitrates has followed with an almost invariable decrease in ultimate yield. Guided by this an experiment has been begun with rotting the trash before application. It is placed in an empty silo, lightly sprinkled with rotted pen manure for inoculation, and water added. This well rotted vegetable matter has been added in two doses of 5 and 15 tons per acre, on unmanured land and with the addition of 186 and 210 lbs. of nitrogen. The results are not yet available, but will be watched with interest, as it is usually held that in tropical soils the heat and moisture are usually sufficient to rot the trash quite rapidly enough for the formation of humus.

Forestry work.—The large project of covering the upper uncultivable tracts with forest and thus retrieving the waste and destruction caused by years of neglect is obviously too large for any individual department to undertake, and the Planters' Association is working in close collaboration with the State Forestry Department. The actual planting up of the denuded areas would take quite a number of years, and some ingenuity is being displayed in attacking the problem in an economical and yet efficient manner, by making use of such aids as nature itself provides. Little need be urged as to the importance of this tree planting work on sugar estates, for we have emphasized it on several occasions recently, and the keen interest shown in it by the Hawaiian sugar planters is of itself an additional argument in its favour. The most recent line has been to call in the aid of the entomologist. After somewhat exhaustive studies by the Forestry department, certain local species of wild figs have been pointed out as very desirable additions to the forest flora. Drought resistant but taking up large quantities of water, growing and fruiting abundantly and capable of rapid distribution by birds which are very partial to their fruits, of large size and with abundant masses of luxuriant foliage, these are some of their useful characteristics. But, although a number of species have been introduced into the islands at various periods, these never fruit, because of the absence of the necessary fruit wasps. These are now being introduced by entomologists employed by the Planters' Association, who have for so long been in other countries collecting insects attacking the major cane pests, and their attention is also being given to numbers of new species of Ficus in the tropics which are deemed desirable immigrants. The first result of this project is reported, in that one of the local figs, *Ficus macrophylla*, has for the first time produced a crop of fertile figs. Large nurseries have now been established in various centres and the plan is to plant groups of different species along the watersheds and then quietly wait for the time of fruiting, when the appropriate wasps will be introduced. Then birds which are inordinately fond of the fruit will do the rest. Of course this is only one line of attack, and large seed collections of many different kinds of trees are constantly arriving and being propagated for planting out, when the Forestry officials approve of their introduction and decide where they should be placed· Meantime, great attention is being given to the accurate demarcation of the various areas of reserve forest land and the heavy spade work is being done for a proper knowledge of the forest limits of each plantation. When several estates have common interests in a block, they unite and pursue a common policy with one nursery available for the united work.

We have considered these four major lines of work in some detail because of their great interest and somewhat novel character. And it leaves us no space to summarize the important work on cane diseases and pests which is also being done. It is interesting here to contrast the policy adopted by Hawaii and Java in these two sections, as showing the extraordinary diversity of sugar cane work under different fundamental conditions. Java with equal scientific equipment has reached a later stage in evolution and, while the mycologist and entomologist are excessively busy in Hawaii, there is practically no work for them left in Java; she has reached the stage when she fights the pests and diseases mainly by cultural operations, and this should be the ideal in all tropical sugar producing countries.

C. A. B.

The Pusa Sugar Bureau, 1920-21.[1]

Report of the Secretary, Mr. Wynne Sayer.

Under the original orders of the Government of India the term of the Bureau was limited to two years. As the question of the Bureau was engaging the attention of the Indian Sugar Committee, the Government of India were moved to extend the term of the Bureau for the period of one year or till such time as definite orders are passed on the recommendation of the Committee, whichever is earlier. This was sanctioned by the Government of India.

Equipment.—The main work of the year consisted in furnishing the Indian Sugar Committee with information on the many and various points required by them, in giving replies to the numerous correspondents who seek the advice of this office on matters connected with the Indian sugar industry, and in developing our relations with the Directors of Agriculture, Directors of Industries, the management of sugar factories in India, and the Directors of Sugar Experiment Stations throughout the world. The Bureau has also been able to give considerable assistance to prospective purchasers of sugar machinery by placing them in touch with sugar machinery manufacturers and arranging for early delivery of the machinery required; and on account of delay in deliveries of machinery, has kept a list of machinery immediately available in England and America for the convenience of enquirers. A press communiqué was published on the subject in August. The raising of the import duty on foreign sugar from 10 to 15 per cent. *ad valorem* with effect from 1st March, 1921, has had the practical effect of giving protection to the Indian sugar industry, and this has stimulated among capitalists the desire for establishing modern factories in suitable localities, for which there is ample room.

During the year Mr. Hall, General Manager of the Honolulu Iron Works, Hawaii, paid a visit to India, and after seeing the class of cane grown has arranged to construct and send out for trial by this Bureau a small power-driven mill, embodying some novel features. I intend to run tests with this mill next season, and wish to express my gratitude to the Honolulu Iron Works for undertaking this piece of work free of charge.

During the year Mr. William Hulme, who was formerly Sugar Engineer Expert under the Government of India, visited this country on the invitation of his clients. He is thoroughly conversant with Indian conditions and is consulting engineer for several factories in India already. Arrangements were made by the Bureau whereby owners of sugar factories and prospective purchasers of sugar machinery were able to consult Mr. Hulme and take advantage of his experience and technical knowledge. Mr. William Hulme's office is in Liverpool, and he is in touch with all English firms connected with the manufacture of sugar machinery. With his knowledge of conditions under which factories have to work in India, he is in an excellent position to advise regarding the class of machinery required. With regard to the manufacture of sugar machinery in India about which I have received enquiries, I may here say that I do not consider that this will be practicable in the near future. Simpler parts of a sugar factory equipment such as pipes, pans, etc., can be made, and a beginning is being made in this direction which will be a great advantage, as these parts although of simpler construction cost proportionately more in freight on account of their weight and size, but rolls, engines, centrifugals, and other equipment entailing special materials and considerable experience in manufacture will have to continue to be imported. As a result of experience gained in the last two years I find the need for a sugar technologist very urgent, but until such an appointment is created the arrangements referred to above will enable me to deal with all enquiries.

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[1] Abridged from "Scientific Reports of the Agr. Res. Inst. Pusa, 1920-21."

Scientific work.—It was stated in last year's report that I brought back some of the latest varieties from Java when I was on tour in that country with the Indian Sugar Committee.

These varieties were E.K. 2, E.K. 28, D.I. 52, S.W. 3, S.W. 111, 66 B., P.O.J. 1410, P.O.J. 1499, and P.O.J. 100, and they were sent to Coimbatore for trial. The last four varieties on examination by the Madras Government mycologist were suspected to have pine-apple disease. Such healthy sets as he was able to select were sown in big-sized pots and kept in quarantine at his pot-culture house for nearly six months before being moved to the cane-breeding station. After rejecting unsound material, 46 germinations were obtained. By cutting up the canes when formed, though in unmature condition, it has been possible to multiply this material into 12,000 plants, which are now growing at the station. This material is considered adequate to form rough ideas about the characteristics as regards sucrose, etc., of these varieties and their value for crossing purposes at the end of the current season. Speaking tentatively, P.O.J. 1410 and 1499 would appear to be the nearest approaches to the inferior types grown in North India, and among others there are some which seem likely to be useful even for places which at present grow medium thick or thick canes. P.O.J. 100 was already in India, but I brought this variety over specifically so that there might be no mistake about its identification as has already happened in the case of P.O.J. 36 and 33. This variety has a fairly high sucrose content and matures comparatively early, and as an early maturing cane is one of the principal needs of factories and growers in North India, I anticipate this cane will form a very useful parent for crossing.

In Java they are able to provide sets of a new variety sufficient to plant 4096 acres at the end of two years from the original area of 1 acre seed cane by a system of growing the canes to six months and then cutting them for sets and replanting. The sets germinate satisfactorily and form canes within six months, thus enabling 1 acre of seed cane to provide planting material for 8 acres of new cane which, at the end of the next six months, give sets for 64 acres, which will plant out 4096 acres at the end of another year of double planting.

As it has been found from trials at Pusa that Coimbatore varieties Co 221, Co 214, Co 213, and Co 210 appear to suit local conditions admirably as regards their yield, sucrose and purity, with the kind assistance of the Imperial Agriculturist, I have laid down a plot under these canes according to the Java method for rapid propagation in order to enable me to get sufficient cane for a full day's mill trial next year, if possible. The results so far seem promising. It is proposed to extend this line of work in future and to give out sets of these varieties to sugar factories and large cane growers. I am also making arrangements for a mill trial in order to ascertain the behaviour of these canes under true mill conditions, which can never be reproduced in laboratory testing. I have also arranged a similar experiment at Dacca, which appears to me to be the district corresponding most nearly to Java conditions in this respect.

As the Fiji disease of cane has been spreading in Fiji, Australia, New Guinea and the Philippines, I suggested to the Agricultural Adviser to the Government of India that this disease should be included in the notification issued by the Government of India under the Diseases and Pests Act of 1914 for prohibiting or regulating the import of canes in India. Similar action was also suggested with a view to prevent the introduction of Mosaic disease in this country

The Question of the Distance between Cane Rows.

A Brief Résumé and some Additional Data.

By ARTHUR H. ROSENFELD.

The latter part of 1920 the author published in the *International Sugar Journal*, under this same title, a résumé of the experiments in all parts of the sugar-producing world on the width of cane middles. A few months ago Dr. W. E. Cross published in the *Revista Industrial y Agricola de Tucumán*,[1] the official organ of the Tucumán (Argentina) Sugar Experiment Station, the results from another crop of the plats of four distinct varieties which are being tried out with varying distances between the rows. It has been thought advisable to include these results, which it may be said *en passant* only verify the conclusions already reached in the previous paper, in a short review of this important subject, thus bringing the matter completely up to date.

As we pointed out in the earlier article on this subject, for each kind of plant and soil there should exist a theoretical maximum of the agricultural yield obtainable, or, in other words, each class of soil in each and every climate is capable, under ideal conditions, of producing an exact maximum of—let us say well developed sugar canes, for example, and this maximum can be obtained only under optimum climatic conditions and with perfect cultivation. Also, most naturally, this maximum will be secured only through an ideal spacing of the plants which will allow each one to attain its *maximum development* and each unit of area to produce the largest possible number of *thoroughly developed* canes. Hence it is logical that too small a space between our cane rows must inevitably result in too large a number of *subnormal* canes, while excessively wide middles will probably produce splendid *individual specimens* of sugar canes, the reduced number of which will fail to give the tonnage obtainable from the theoretically ideal number of plants of *normal* development. All experiments on the subject are, naturally, aimed at determining for distinct zones and distinct varieties just the spacing which will produce the largest *per acre* yield at the smallest *per ton* cost.

TABLE I.

COMPOSITE RESULTS OF EARLY LOUISIANA EXPERIMENTS.

Width of Middles Ft.	No. of Stalks per Hectare.	Average Weight of Stalk. Grms.	Cane per Hectare. Metric Tons.	Chemical Analyses of Juices.				Number of Crops.
				Brix.	Sucrose.	Glucose	Purity.	
3	75,010	1300	85·0	14·2	10·7	1·53	75·35	14
4	68,150	1250	79·2	13·9	10·4	1·62	74·82	14
5	69,800	1300	82·5	14·0	10·6	1·54	75·72	18
6	66,334	1300	82·1	14·0	10·7	1·66	76·43	12
7	66,371	1250	82·0	14·3	11·0	1·66	76·92	6
8	62,286	1350	78·1	13·8	10·3	1·72	74·64	6

In the previous article attention was first called to the classic experiments made by Dr. W. C. STUBBS in Louisiana in investigating this point, these experiments dating back to 1888.[2] Table I is a composite of the results of all of Stubbs' distance experiments, as shown in Tables I—VI of our earlier paper. These experiments were all made with the Louisiana Striped and Purple canes (*Cheribon*) and the cane planted in rows 3 ft. apart gave uniformly the best tonnage per hectare, although the increase over the 5 and 6 ft. rows would work out at only about one ton per acre—not sufficient to compensate for the additional plant cane required for the more narrowly spaced rows, particularly as cane is seldom carried beyond first year stubble in the Pelican State.

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[1] Distancia a que se debe plantar la cana de azúcar.—Tomo XI. Nos. 9-10.

[2] Sugar Cane: Results in Field and Laboratory in 1890. Bull. 14, 2nd Ser.

The lowest yield per hectare has been given by the 8 ft. rows, which is manifestly an impossible spacing for this type of cane at any rate, on account of the large number of late cultivations necessary for weed elimination after the narrow spaced middles are entirely covered by the almost overlapping cane and, also, because very widely spaced cane offers less physical resistance to frost than closer-grown plants and this is an important consideration with Louisiana's adverse winter climate.

It is notable, too, that the 8 ft. rows, contrary to general opinion, have given cane of the lowest sugar content and purity and highest glucose ratio. There can be no doubt, however, in the mind of any observant person closely associated with sugar cane that this huge grass is a *sociable* plant and develops best under normal conditions of spacing. The rapidity with which any very much thinned out canefield will entirely die out is a common observation among cane agriculturists.

After the 8 ft. rows the 4 ft. ones give consistently the poorest results in all of these Louisiana experiments. As no implements could be got between the 3 and 4 ft. rows no cultivation was given these middles in any case, and it is probable that, while the additional number of rows per hectare with the 3 ft. rows compensated for this lack of cultivation, this was not the case with the 4 ft. rows. It is likewise noticeable that the 4 ft. rows also gave juices of second lowest quality throughout. As between the agricultural yield or analyses from the other three series there is very little indeed to choose, and the conclusion is obvious that, considering the increasing number of light cultivations necessary with widening middles, the logical procedure indicated by these results is to select the narrowest middles consistent with the entrance of proper cultivating machinery, since, in these days of increasing labour troubles, a return to the old methods of hand cultivation is totally unthinkable. Mechanical cultivation is efficiently accomplished in 5 ft. middles, and these rows close sufficiently early under normal conditions to make a great number of light middle cultivations unnecessary.

Up to the time of the above-described experiments most Louisiana planters used 6 ft. rows, but 5 ft. rows were almost universally adopted after the results of these extensive tests had been published and discussed by STUBBS.

There is a fairly steady increase in number of stalks per hectare, as is to be expected, as the width of the middles decreases and the number of rows per hectare increases, and in this connexion STUBBS makes an interesting and pertinent observation. He found, after counting the number of canes per row at the time of throwing the first dirt to the cane, at lay-by and at crop, that many canes perish due to lack of space for growth. This was particularly notable in the stubble cane with narrow middles, the counts demonstrating that 50 per cent. of these canes had died before reaching maturity. Many canes measuring 3 ft. in height were found dead at crop time from no other apparent cause than the lack of room for development. This observation explains how it often occurs that a poor stand of plant cane may produce fairly good stubble, particularly with strongly ratooning varieties.

In Hawaii, R. E. BLOUIN,[1] after his 1901 experiments with the Lahaina cane, planted at 4, 5, 6 and 8 ft., showed that the 5 ft. rows produced 60 tons more cane per hectare than the 6 ft. rows, which occupied second place, concluded that the

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[1] Hawaiian Sugar Planters' Experiment Station, Bulletin No. 7.

Hawaiian planters—who almost universally employed 5 ft. rows—had no reason whatsoever for deviating from this practice. REYNOSO gives the ideal distance between Cuban rows as 5½ ft. and BONAME concluded that 4½ to 5 ft. was best for Guadeloupe. Large sub-station experiments under the author's direction in Tucuman Province, Argentina, with Cheribon Striped and Purple with rows at 5, 6, 7 and 8 ft., showed by far the best yield for the 5 ft. rows, which gave 24 metric tons more cane per hectare than the 6 ft. rows and a gradual decrease in yield per hectare as the rows were placed farther apart, the 8 ft. rows giving by far the smallest yield. A calculation of the financial gain—always the prime consideration in any agricultural experiments—with the 5 ft. rows over the 8 ft. ones, based on the price of cane to the planter at the time the experiments were made (1913), showed an advantage of $168·00 (U.S.) per hectare.

In 1917, 1918 and 1919 the writer conducted a large series of experiments, covering some one hundred and twenty acres, at the Santa Ana sugar factory in the Province of Tucumán, near where the substation distance experiments had been located, with 5, 6, and 6⅔ ft. rows, the 5 ft. rows averaging over 20 tons more cane per hectare per annum than the wider spaced rows. These experiments were made with the erect-growing P.O.J. 228 cane.

The substation experiments at Monte Bello and the Santa Ana tests, being both on a very large scale and in the same district, may properly be averaged, the results for the 5 and 6 ft. rows being shown in Table II.

TABLE II.

AVERAGE RESULTS FROM FOUR CROPS AT MONTE BELLO AND SANTA ANA.

1913-1917.

Width Middles, Feet.	Metric Tons Cane, per Hectare
5	55·7
6	42·8

TESTS AT THE TUCUMAN SUGAR EXPERIMENT STATION.

The experiments at the Tucuman station were commenced in 1910 under the direction of Mr. R. E. BLOUIN and continued by the author until 1916. Since that time Dr. W. E. CROSS, who succeeded the writer as Director of that institution, has continued the experiments up to the present time. The author is very much indebted to Dr. CROSS for the data in these pages relating to experiments at the station since 1916.

The first series of experiments was made with Purple Cheribon cane and ran through first year stubble. The 4 ft. rows led in production per hectare, being followed by the 6 ft. ones by a small margin. The 3 ft. rows averaged about 2 tons more cane per hectare than the 5 ft. rows, which were far ahead of the 7 and 8 ft. rows in production per hectare. BLOUIN[1] concluded from these experiments that, considering the important question of proper mechanical cultivation, the distance between cane rows in the Province of Tucuman should not be less than 5 ft. nor more than 6, recommending 5½ ft. for the type of cane then in use in the Province.

About this time, however, the heavily-suckering, rapid growing and somewhat frost-resistant Java canes, P. O. J. 36, 213 and 228 had begun to attract wide attention in the Argentine sugar district and in 1915 the author commenced a series of distance experiments with the P. O. J. 36 variety. The following year another series was initiated with the P. O. J. 213, a variety of very distinct type of growth from the P. O. J. 36, the latter being much more erect and having much less tendency to fall late in the season in times of very heavy rainfall. In 1916, also, experiments were begun with the now famous Kavangire (Uba) cane and with another variety of the bamboo type, which was imported into Louisiana from Japan by STUBBS and thence to the Tucumán Sugar Experiment Station by BLOUIN—called Zwinga.

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[1] *Revista Industrial y Agricola de Tucuman*, Ano III, pp. 474-7, 1913.

In our previous paper results were given for four crops from the P. O. J. 36 series (one of plant and three successive stubble croppings) and for three crops each from the original P. O. J. 213, Kavangire and Zwinga plantings. CROSS has now published[1] the 1920 results from these four series of experiments with extra-prolific types of cane, the results in each case thoroughly confirming the conclusions already reached in our earlier article—so much so that, instead of studying in detail the results from the individual series, we have averaged the results obtained from five crops of the P. O. J. 36 and four each of the P. O. J. 213, Kavangire (Uba) and Zwinga in a composite table showing the results from the two distinct classes of cane—the Java and bamboo types—during the years that they have been under trial at the Tucumán Station.

TABLE III.

COMPOSITE RESULTS FROM SEVENTEEN CROPS OF P.O.J. 36 AND 213, KAVANGIRE AND ZWINGA, 1915-1920.

Distance between Rows. Ft.	STALKS.			Cane per Hectare. Metric Tons.	Sugar per Hectare. Kgs.	Number of Crops.
	Per Row, 100 Metres.	Per Hectare.	Average Weight. Grms.			
		(A) *Java Canes.*				
3	930	103,222	568	58·9	5578	9
4	1190	99,000	605	60·1	5796	9
5	1374	91,766	633	57·8	5527	9
6	1587	88,361	657	57·8	5736	9
7	1809	86,143	693	57·9	5707	9
8	1973	82,479	671	54·9	5674	9
		(B) *Bamboo Canes.*				
3	1808	217,500	309	61·3	3338	8
4	2302	191,792	330	62·7	3444	8
5⅓	2776	173,469	351	60·0	3349	8
8⅓	3856	154,220	396	59·7	3696	8

With the exceptions of the plats planted at 8 ft. or over, the yields of cane per hectare in each of the two series vary so little between themselves at the different distances as to fall well within the limits of permissible experimental error, the extreme variation in yield of cane per hectare being under three tons (about one ton per acre). In each series the average weight of the individual stalks varied directly with the widths of the middles and it is also apparent from the sugar yields, as with our previous experiments, that the distance of planting exerted no appreciable effect on the sugar content or purity of the juices.

The number of stalks per hectare in both series increases, as is to be logically expected, inversely with the width of the middles and this point is of more than academic interest, since, as CROSS points out, the decreased average weight of stalk in the closely planted rows is due entirely to decreased thickness of the canes, and this signifies a greater number of canes *per ton* to be cut, stripped and topped in the field as the middles are narrowed. This, naturally, means more time and expense in handling, and should be taken into serious consideration in deciding on the distance to be given the rows.

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[1] *Loc. cit.*

CONCLUSIONS.

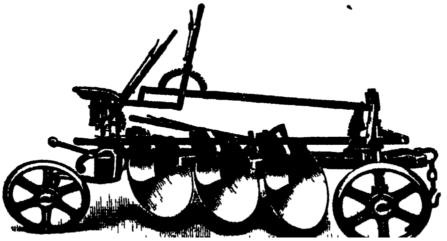
After going over the entire subject and considering the results of recent experiments, our conclusions may be expressed in exactly the same terms employed in concluding our earlier article on this subject, viz.: "We may safely conclude that sugar cane should be planted in rows just as close together as is consistent with proper cultivation with modern machinery, this distance appearing to be about 5 ft. for the thicker type of cane such as the Cheribon, Lahaina, B 208, etc., and from 5½ to 6 ft. for the more abundantly suckering types such as the Java canes, the Uba, the Bamboo class, etc."

Some English Implements for Sugar Cultivation.

We had the opportunity the other day of seeing one of the old catalogues of Messrs Ransomes, Sims & Jefferies, Ltd., of Orwell Works, Ipswich, dated 1854, in which it was stated that the Y.C.P.W. Plough, made by the predecessors of the present firm, was at that time in general use in the West Indies, Cape of Good Hope, and United States. This plough, of which we give an illustration, has been the favourite plough in the West Indies for sugar cultivation since that distant period. It is of great strength, and made specially high at the junction of the beam with the frame to allow deep ploughing or to clear any rough herbage. It has a very deep steel breast which enables it to make high ridges, as well as to be used for close or ordinary ploughing Of recent years, a double-breasted body has been provided for this plough to replace the single-breasted one, when required, and with this, deep trenches can be made suitable for planting cane cuttings. This plough is considered by those competent to judge one of the best on the market.

Ransomes' Y C.P.W Plough.

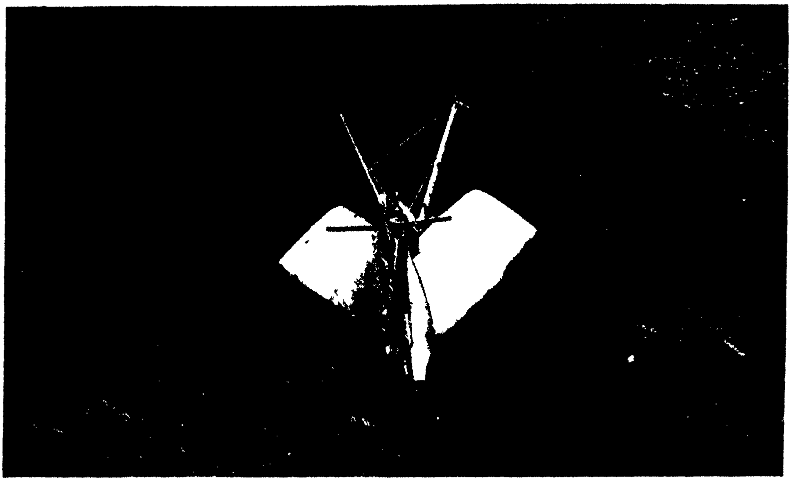
One of the finest implements for cultivating the land for sugar cane growing is the disc plough, which has come into great favour in all tropical countries during the last 20 or 30 years. Messrs. Ransomes, Sims & Jefferies, Ltd., have had great success with their "Defiance" and "Key-Conqueror" series of disc ploughs which combine ready penetration, easy manipulation, and great strength. These ploughs are made for from one to six furrows. They are well suited for breaking up new land as well as for ordinary ploughing and deep cultivation, and can be drawn by bullocks or any kind of tractor. The makers supply them when required in special cases with a land wheel attachment for bringing the



Three-Furrow "Key-Conqueror" Disc Plough.

land wheel close in to the frame of the plough, thus enabling the planter to plough close up to a drain or to growing crops. This offers a great advantage to cane cultivators, as with the ordinary disc plough the planter has often to send men to follow the plough and do by hand what this plough with its attachment will complete in one operation.

The most important operation in connexion with sugar cultivation is probably that of making the "planting furrows" and ridges For this purpose Messrs Ransomes' offer their "R N.R.W." and "R.N.R.L.W." ploughs, both capable of making ridges four feet and over apart, or narrower if required. These ploughs are largely used for sugar cultivation in Java, South Africa, and elsewhere, and below we illustrate one of them in position in the furrow just produced.



Messrs. Ransomes, Sims & Jefferies, Ltd., likewise make a series of self-lift and steerage ploughs and implements which are designed for use with any kind of tractor. One of these implements is shown below at work on rice cultivation with a "Cletrac" Tractor, in Demerara.

The favourite patterns for export use are the "Dictator" and "Autocrat," 2 and 3-furrow. They will cut furrows 14 in. and 12 in. wide respectively, and will work to a depth of 8 to 9 in. These tractor ploughs are of the most modern and up-to-date construction, embodying numerous patents, and ensuring perfection of work and the greatest facility of manipulation.

This firm also make subsoil ploughs to be drawn by tractors (capable of ploughing down to 16 in. deep), tractor cultivators, harrows, stubble breakers, etc. We illustrate below one of the "Dauntless" Self-lift Tractor Cultivators working on sugar cane on the Cane Grove Estate, Demerara

It may be stated in conclusion that Messrs Ransomes, Sims & Jefferies, LTD., are one of the oldest British firms manufacturing agricultural implements. They started as far back as 1789, and their implements are known in every part of the civilized world where desire is had for good design and durability, features that are not always evident in the case of some of the cheap types at present on the market.

The Czecho-Slovak beet sugar output from the 1921 crop is put at approximately 650,000 tons. About one-half will be available for export, and sales have already been effected to the amount of 125,000 tons. In 1920-21 the exports amounted to 414,376 tons, and in 1919-20 to 340,516 tons, France in both years being the largest single purchaser.

Experiments of a preliminary nature on the conversion of bagasse into a nitrogenous fertilizer have been carried out by K. A RAO [1] Inoculation was effected with *Azotobacter*, *Radicicola* and *Elostridium*, and after two months' action the bagasse was found to have been converted into a material containing 1·2-1·4 per cent. of nitrogen.

The *West India Committee Circular*[2] draws attention to a lecture delivered last month by MR. GEOFFREY FAIRRIE (of Fairrie & Co., Ltd., refiners, Liverpool), who "revived some of the old-time statements made by the refiners as regards the horrible things to be met with in raw sugar," these including *Acarus sacchari*, moulds, bacteria, etc. Our contemporary, in a short article headed "A Fairrie Tale," comments upon MR GEOFFREY FAIRRIE's remarks as follows:—"He also showed his ignorance of modern methods of manufacture of direct consumption sugar by stating that the process of manufacturing sugars abroad was carried out largely by natives whose habits were neither altogether unobjectionable nor characterized by scrupulous cleanliness. Mr. FAIRRIE lives in an age long past as regards tropical sugar-making. . . . . ."

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[1] *J. Madras Agric. Students Union*, 8, No. 7, 184–189.

[2] 1921, 36, No. 606, 540.

Some Notes on the Cuban Sugar Industry.

(By our Havana Correspondent.)

The present Cuban crop which commenced in December had about 50 factories in operation by the middle of January, and by the time these lines appear a good many more will be in full swing turning out new sugars.

With over one million tons of old crop sugars still in the warehouses unsold, and the price of sugar at such a low point, the starting of so many factories must appear to many as creating an extraordinary situation, tending as it does to glut the market. It immediately raises the question: Can sugar be made profitably under these conditions?

In answering that question a number of points have to be taken into consideration which are as follows:—

(*a*) Canes are bought on a sliding scale according to the price of sugar, and on very few places is there a fixed minimum price.

(*b*) Where prices paid for canes were high, a readjustment is taking place on many properties, so that the factories are encouraged to grind.

(*c*) Very little money has been spent in the fields during the growing season, and in many districts nothing has been spent; which means that the cost of growing cane for this crop amounts to little or nothing. This fact allows the farmer, or cane grower, to accept a readjustment to a lower level in the price paid for his cane.

(*d*) Very little money has been spent on the maintenance of the factories, the railroads and rolling stock serving the factories, and therefore manufacturing expenses, which include the maintenance, ought to be low.

(*e*) Labour is accepting a big cut in wages, and is back to pre-war prices, and in some cases, less.

(*f*) On many plantations the workman has been getting food only for his labour, and this will be continued in many instances, perhaps for the period of the crop.

Thus with large crops of cane ready for harvesting and practically no money spent on the crops so far, one can almost say that the only costs being incurred are the costs of harvesting, transport and manufacture, and this coupled with the fact that labour is hungry and willing to work for anything within reason for the time being is the impetus that has started many of the factories even in the face of low prices and has enabled Cuba to do almost the impossible. The most important factor towards achieving success is the readjustment of prices both for cane and for labour; on this the whole situation rests.

This does not mean that the producers are losing on their operation nor on the other hand does it imply that profits will be made; all it amounts to is that the farmers and factories will at least cover expenses, while well managed concerns and big factories will do a little better, notwithstanding the very low prices sugar is fetching.

It is impossible at the moment to give any close estimate of the extent of the present crop; but if prices stiffen just a little, considerable encouragement and a big impetus will be given to the manufacture of sugar in Cuba and the island will again demonstrate her ability to produce much sugar under unfavourable conditions.

Hot Water versus Cold for washing Sugar from Bagasse.

By MAURICE BIRD, B.S.

Among the questions that arise in the manufacture of sugar, concerning which there is a widespread doubt as to whether they should be classed as facts or fallacies, is that of the validity of the claim that cold water is equal or superior to hot for maceration purposes at the mill.

To many it seems self-evident that hot water must be a better solvent of sugar from bagasse than cold; but the question must be taken seriously since not only laymen but technical men, chemists and engineers, holding positions of responsibility, have been known not only to advocate, but to practise, the use of cold water for maceration purposes.

The usual arguments of the cold water theorists are that hot water extracts more impurities than cold, and that the heat, added to that produced by the friction of the mill, causes danger from undue expansion of the shell of the roller, heating of the headstock brasses, etc., while some even go so far as to consider that cold water will extract more sugar than hot.

A study of the residual juice of bagasse has convinced the writer that maceration water largely displaces the juice rather than dilutes it, and so washes out the sugar, and as hot water is more penetrating it seems reasonable to conclude that it will displace more juice from the broken cells; also, as heat is a clarifying agent it is rational to conclude that some of the impurities, e.g., the albuminoids, are coagulated and left behind.

Again, when it is considered that maceration water, to be effective, must be sprayed into bagasse emerging from a mill, and that if heat be introduced it can hardly affect the mill from which the bagasse has come, being largely dissipated before the bagasse reaches the next mill, there can be little or no danger from its effect upon the machinery; and, indeed, this is apparently borne out in practice, for I can hear of no authentic case of damage to the crushing plant from the use of hot water. Being chemist to three factories, two of which have triple crushing with hot water maceration, while the third has recently enlarged its milling plant to quadruple crushing, cold maceration being employed, the writer has had an opportunity of demonstrating conclusively that not only is it much more profitable to use hot water, but that this is practically indispensable to obtaining the high extraction of sugar from the cane, which is the object of expensive modern multiple crushing plants.

Although the actual crushing at the quadruple factory was very superior to that of either of the two factories employing triple crushing (the moisture in the bagasse being several per cent. lower), and although a much larger quantity of maceration water was employed, yet paradoxical as it may seem, the extraction of sugar from the cane was markedly inferior, the sugar left in the bagasse being about three-quarters of a per cent. higher.

Trials with hot water maceration were made, with the following results:—

	MACERATION.	ANALYSIS OF BAGASSE.		ANALYSIS OF DILUTE MILL JUICE.	
	Per cent. Juice.	Sucrose, per cent.	Moisture, per cent.	Lbs. Sugar, per gallon.	Quotient of Purity.
Cold water (84°F.)	about 27	3·38	43·40	1·209	76·1
Hot ,, (148°F.)	,, 27	2·60	41·64	1·223	76·1
Cold ,, (84°F.)	,, 27	3·51	43·46	1·226	77·3
Hot ,, (160°F.)	,, 27	2·86	41·38	1·109	75·1

Hot Water versus Cold for washing Sugar from Bagasse.

As this factory makes about 6000 tons sugar the increase in the crop, due to a decrease of 0·75 per cent. sucrose in the bagasse, works out at 150 tons in favour of hot water maceration. This was then adopted, and the weekly average per cent. sugar in bagasse was 2·88, against a weekly average of 3·64, when cold water was employed. Also with the same steam utilized by the juice heater, a higher temperature, and consequently better clarification, is obtained for the juice, when hot maceration is employed.

Another advantage derived from its use is that the bagasse dries out perceptibly on its way to the furnace, as the following figures show:—

AVERAGE MOISTURE PER CENT. BAGASSE AT TRIPLE CRUSHING FACTORY.		AVERAGE MOISTURE PER CENT. BAGASSE AT QUADRUPLE CRUSHING FACTORY.			
Hot Water Maceration.		Cold Water Maceration		Hot Water Maceration.	
Leaving Mill.	Entering Furnace	Leaving Mill.	Entering Furnace.	Leaving Mill.	Entering Furnace.
48·10	47·54	43·88	44·56	45·35	44·54

The above figures are averages of tests, extending over several weeks, which were carried out with the greatest care, and which may be accepted as reliable. They show that well-crushed bagasse from cold maceration tends to absorb moisture, while that from hot maceration, when sent straight to the furnace dries out on the way, and consequently furnishes a better fuel.

As juice heaters and evaporators yield an abundance of hot distilled water, it will be found highly profitable to see to it that no maceration water goes on the mill under 150°F., for no sugar is more cheaply produced than that which is washed from the bagasse, it being a true adage that on sugar estates the money is made in the field but saved in the factory.

Progress in Hawaii in the Design of Sugar Manufacturing Machinery.

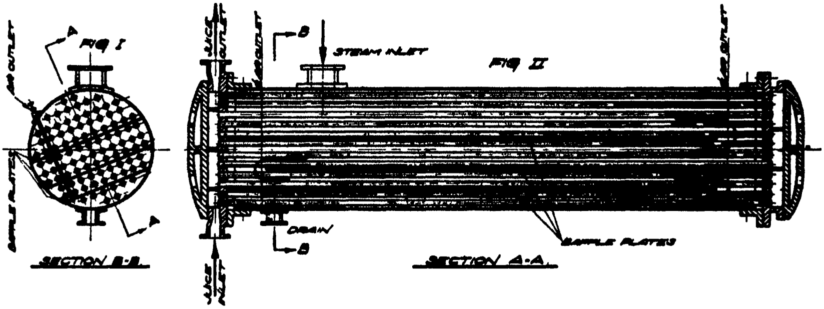
The Committee on Manufacturing Machinery appointed by the Hawaiian Sugar Planters' Association, consisting of Messrs. A. F. EWART (Chairman); W. A. RAMSAY; H. JOHNSON; J. N. S. WILLIAMS; W. G. HALL; E. KOPKE; and J. WEBSTER, have now issued their latest report dated September 20th, 1921. The following is a summary covering the most essential points.

JUICE HEATERS.

The so-called Deming juice heater was first developed in the early nineties at the Ewa mill, T.H., where data regarding the juice heated per sq. ft. of h.s., juice velocity, and steam pressures were obtained. Mr. DEMING then began to manufacture these heaters, and sold them extensively to the Hawaiian factories.

In practice it is found that the maximum capacity of this type of heater is about 60 lbs. of juice per hour per sq. ft. of h.s., when the juice velocity is about 6 ft. per second, the steam pressure in the body about 4 lbs. per sq. in., and the increase in the juice temperature from 80° to 212°F. (27° to 100°C.).

Regarding the control of the factors upon which the capacity of any heater depends, the following remarks may be made: *(1)* The heating of the juice should be done with low pressure steam only, either exhaust from the engine, or vapour at say 4 to 5 lbs. from a pre-evaporator. *(2)* The conduction of the heating surface depends upon the cleanliness of the tubes, which is affected by the scale-forming ingredients of the juice and also by the velocity of the juice. *(3)* The water forming on the heating surface by the condensation of steam reduces the conduction of heat by a considerable amount, the ideal method of eliminating which objection would be to carry away the condensate from the heating surface as soon as it forms. (*4*) A good scouring velocity and one that does not cause an objectionable frictional resistance is about 6 ft. per sec.



SPECIAL H.W. JUICE HEATER WITH BAFFLES

In the juice heater illustrated in the accompanying diagram, two things are accomplished: the condensate is voided as it forms on the tubes, and a decided steam velocity along the tubes is brought about, the direction of the steam flow being practically counter-current to the flow of the juice.

It is seen in the drawing that the rows of tubes are slanting. Section *A A* shows the front plate, the arrangement of tubes, the steam baffle, condensate drain plates, bottom and top air-vents, and also the steam inlet nozzle and condensate outlet. Turning to the length section of the apparatus, it will be seen that the steam enters through the upper nozzle into the comparatively large space of the cell above the upper slanting steam baffle, or condensate drain plate. This plate is placed close against the head nearest the steam inlet nozzle, but leaves an open space between it and the opposite head. The steam is induced to flow (as indicated by the arrows) along the upper bank of tubes, and to turn at the end of the plate down into the next lower space. This flowing to-and-fro of the steam is repeated as often as there are plates in the cell, until it is condensed and flows off through the condensate outlet.

The comparatively high steam velocity induced by the partitioning with baffle plates aids the separation of condensate from the tubes. The drip from the upper bank of tubes falls on to the slanting plate, and is delivered to the shell of the heater away from the next lower one. Between the edge of the plate and the shell is ample space to allow the condensate to flow through, the same occurring in the rest of the compartments until the outlet is reached.

Another important feature of this design is that the baffle plates are placed so that the cross-sections of the different compartments decrease in area from the top down. The steam is reduced in volume through loss of heat from one compartment to the next, but an approximately even steam velocity is maintained.

The sum of these changes has increased the capacity of the heater, compared with the old design, per sq. ft. of h.s., about 100 per cent. Thus, two old juice heater cells, 31 in. diam. with 1¼ in. No. 16 gauge copper tubes, 11 ft. 7 in. long, were refitted as nearly as possible in accordance with the design outlined above. The h.s. for the two cells totalled 800 sq. ft., and under the old conditions when the two were arranged in series they were just right for heating 800 sq. ft. ×

60 lbs./2000 = 24 tons of juice per hour. After the change, however, one heater only proved to be capable of heating this amount of juice, if the steam pressure was not less than 4 lbs. per sq. in. Moreover, pumping juice through one cell instead of two required only one half the pump power, reducing the pressure on the heads by one-half.

When changing old heaters to the improved design now described, the steam connexions must be made amply large, and the following table gives the correct sizes of the pipes to carry steam at approximately 100 ft. per sec. to heat juice from 80° to 212°F. (27° to 100°C.).

Lbs. steam per sq. in.	TONS OF JUICE HEATED PER HOUR.										
	10	15	20	25	30	35	40	45	50	55	60
0	6	8	9	10	10	11	12	13	13	14	14
1	6	7	8	9	10	11	12	12	13	14	14
2	6	7	8	9	10	11	11	12	13	13	14
3	6	7	8	9	10	10	11	12	12	13	13
4	6	7	8	9	9	10	11	11	12	13	13
5	6	6	8	8	9	10	10	11	12	12	13
6	5	6	7	8	9	10	10	11	11	12	12
7	5	6	7	8	9	9	10	11	11	12	12
8	5	6	7	8	9	9	10	10	11	12	12
9	5	6	7	8	8	9	10	10	11	11	12
10	5	6	7	8	8	9	9	10	10	11	12

KOPKE CLARIFIER.

Mr. E. KOPKE summarized the experience gained by him in operating his centrifugal[1] for the clarification of juice and molasses, and the most important points are here summarized.

In 1912 seven 40 in. × 24 in. machines of the Kopke design were installed in one of the Hawaiian factories for the purpose of clarifying the limed and heated juice of 30 tons of cane per hour, and at the same time exhausting the mud. After three seasons, the machines were converted into sugar-drying centrifugals, the objections to the juice-clarifying installation being as follows: (*1*) The juice coming from the machines was found often to be under-limed or over-limed, and this difficulty was never obviated; and (*2*) men more highly skilled than with the tank and mud-press system were required. It happened also at that time that new sugar-drying machines were urgently required, being unobtainable in the market.

Another factor detrimental to the process is that the juice and lime are in contact for a very short period only, as compared with the settling tank method, and it would appear that the coagulation of the albuminoid matter requires more time than was given in the centrifugal process, this being particularly noticeable with certain juices. Another point is that however well the thin-juice may be clarified, a precipitate will always form during concentration, appearing in the syrup, and later in the molasses.

In fact, the removal of the precipitate from the syrup and molasses appears to be of great benefit; and with this idea in view a 40 in. × 24 in. Kopke machine was fitted up in the Makee Sugar Co.'s factory for the clarification of the syrup and molasses. It was used constantly during four seasons with beneficial results.

Dr. R. S. NORRIS, Technical Chemist of the Experiment Station, reported on these experiments on the centrifugal clarification of molasses. He explained that during 1916 a certain factory had been filtering all its clear juice from the settling tanks through cloth; and it had occurred to him that it would be of interest to determine whether this filtration removes the constituents forming the solid impurities always present in the molasses subsequently obtained. Accordingly, the molasses from the factory working with filtered juice was diluted to 55° Brix, heated to 65°C., passed through the Kopke centrifugal, and washed with water. About 3 per cent. of deposit was obtained, which amount would be about the same as would result from molasses from unfiltered juice. It was concluded that the filtration of the juice had but little effect in lessening the solid impurities normally occurring in the molasses. The composition of this deposit resembles evaporator scale, except in the large proportion of organic matter, and consisted of calcium phosphate, 9; calcium sulphate, 17; and organic calcium compounds, 22 per cent.

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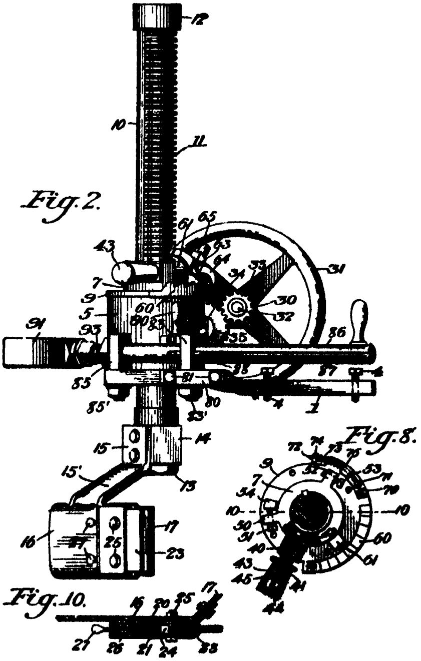
[1] *I.S.J.*, 1915, 146, 245, 291, 339.

Mr. E. W. Kopke, Superintendent of the Makee Sugar Co., also made a report on the experiments on the centrifugal clarification of molasses carried out at his factory by Mr. E. Kopke. He gave details of the tests, and summarized as follows the improvements to be noticed as the result of the molasses clarification.

(1) There is a decrease in the amount of the low-grade products. Thus, during the previous season when 100 tons less sugar were made, there were 40,000 galls. of third boilings in the tanks, whereas after molasses clarification there were less than 5000 galls. (2) The period of boiling is diminished. During the previous crop it had taken 18 to 20 hours to complete the strike; but after molasses clarification, even with the greater dilution of the first molasses, the strike was completed in 12 to 14 hours. (3) An improvement was noticed in the time of formation of grain, while the pan coils were cleaner. (4) As the result of the diminution of the viscosity, and the better formation of grain due to the elimination of the sludge, an improvement in the curing of the sugar in the centrifugals was observed. No dilution with molasses was necessary, and the molasses thrown out had a Brix of 90° or over.[1] (5) Then final molasses of low purity resulted, 34° and 35° gravity purity being frequently obtained.



Daniels' Centrifugal Discharge.

Daniels' Centrifugal Discharge.

Mr. Edmund Daniels, engineer of the Pioneer Mill, T.H., has constructed a centrifugal discharger,[2] several of which have been operated during this and the last season.

Its most prominent points are: (1) The exclusion of the possibility of the cutting chisel coming in contact with the perforated metal screen, thereby damaging it. (2) The positive holding of the centrifugal spindle in position when the discharger is being forced into the mass of sugar by the strut with its semi-circular roller bearing. (3) The minimum work done by the fibre scraper when pushed against the perforated centrifugal screen by the chisel to remove the layer of sugar left on the screen.

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[1] A Brix of 97·8 is stated to have been found in the case of a massecuite which had been in the crystallizers for 8½ days. It was obtained by the Station chemist, who repeated the determination with the same result. Other high densities recorded were: 94·5, 92·7 and 92·3.

[2] U. S. Patent, 1,388,173; *I.S.J.*, 1922, 50.

Revolving Cane Cutting Knives.

Mr. Alfred M. Simpson, of Honolulu, T.H., has invented a design of cane cutting knives,[1] which embodies a cylindrical shaft, journalled on either end. The ends extend beyond the journal to receive a pulley for belt drive or a coupling for motor drive; while the part of the shaft between the journals has four featherways, equally spaced and running lengthwise. On this shaft are mounted any number of hubs.

As indicated in the illustration, the hub and the body of the knife is a steel casting, on to which is welded a cutting part of spring steel. There are two knife bodies diametrically opposite on each hub. Each hub is fastened on to the cylindrical shaft independently, so that any one may be removed or replaced without interfering with adjacent ones. The hub, together with a clamping cap, is bored to the size of the shaft, and is prevented from turning on the shaft by friction produced by the clamping cap being forced against the shaft by the two stud bolts, and more especially by a feather secured in the caps and engaged in one of the four featherways in the shaft. The feather fastened in the hub is made somewhat longer than the thickness of the hub for the purpose of preventing binding of the hub faces between the adjacent ones and thereby facilitating the removal and replacing of a hub.

Fig. 1

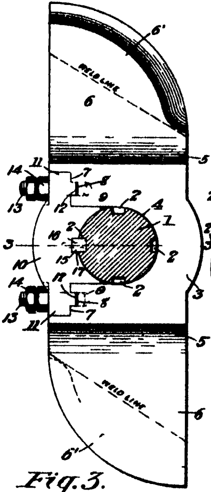


Fig. 2

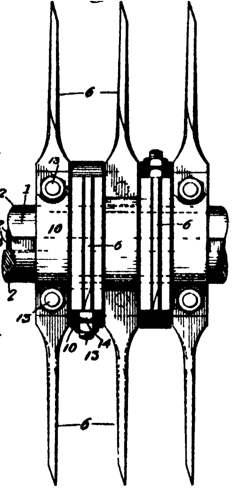
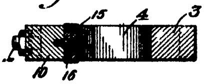


Fig. 3.



In order to prevent the opening of the jaw of the hub (that is, that part of the hub into which the clamping cap fits), two projections in the cap, transversely central with the stud bolts, fit into the hub.

The points of superiority in this design of a revolving cane knife are as follows:—(1) The hub and knife bodies are cast integrally. This admits a large fillet at the base of the knife body and the hub. It is at this place where other knives, either bolted to a hub or clamped between two hubs, fail.

2. Each hub being held in its position independently of all other hubs, and there being no side strain between one hub and the adjacent ones, the shaft cannot be distorted, as is the case where a number of hubs have to be clamped together by longitudinal bolts or large nuts on the end of the shaft.

3. Any one of the hubs may be replaced in a few moments without interfering with adjacent ones.

4. The balance will not be disturbed if one or more hubs were removed entirely.

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[1] U. S. Patent, 1,396,600.

Recent Work in Cane Agriculture.

EXPERIMENTS WITH VARIETIES OF SUGAR CANE 1918-1920. *H. A. Tempany. Bulletin No. 23, General Series, Department of Agriculture, Mauritius, 1921.*

For the plan of these experiments and the methods of investigation adopted the reader is referred to our note in last June's number of the Journal,[1] where the results for the years 1917-1919 were dealt with. The experiments have been continued on similar lines, but expanded in various directions, all of them likely to be useful to the planters.

An attempt is now made to separate the results obtained in the experiment stations into two groups, according as these are situated in the lower and upper cane growing districts, the dividing line being placed at 500 feet above sea level. It is now also for the first time possible to include ratoon crops, as well as those for plant canes. Further details are given in the tables of analysis, which now include the number of plots, sucrose per cent. in the juice, sucrose in the cane, fibre in cane, tons of cane, and kilograms of sucrose. The two last are sometimes given per acre and sometimes per arpent. Although these two are practically synonymous, they are not quite so, and it would be better, we think, to stick to one measurement throughout.

There are considerably more tables in the present report. The first gives, as before, a brief description of the varieties, which are classified according to origin. Tables II and III give average analytical and crop details, comprising the mean results obtained for each variety from all the stations where it is grown, the plant canes being separated from the ratoons. The remaining tables give the kilograms of sucrose per acre or arpent with a separation of low and up country stations. Table IV deals with plant canes in 1920 and Table V with ratoons; Table VI gives the means of plants and ratoons in each variety in 1920, while Table VII gives the average for the two seasons 1919 and 1920. General conclusions are drawn from these tables as to the best varieties to be grown, whether in all parts, or in the low and up country, and the history of eight of the most promising is given in a series of short paragraphs. A short statement is made of the progress of the selection work in the local seedlings raised in 1917, 1918, and 1919. Of the 3436 seedlings raised in 1917, nine are thought to evince considerable promise and are to be included in the general series of experiments in the next season.

A SIMPLE POLLINATING APPARATUS. *T. S. Venkataraman. Agricultural Journal of India, Vol. XVI, p. 203, 1921.*

This short paper gives an illustrated description of the apparatus designed and successfully used by the author for the past five years at the Coimbatore Cane-breeding Station. It provides for accurate and economical cross-pollination and appears to ensure complete control in this rather delicate operation. The pollen of the male parent is collected in tissue paper bags on the previous evening or early on the morning of the experiment, long before the anthers are ready to burst for the day, and is passed through a fine-mesh sieve to free it from dirt or bits of anthers, stigmas, etc. It is then loaded into small gelatine capsules obtainable from any chemist. After loading, the edge of the lower half of the capsule is slightly moistened, and this causes the upper portion which slides over it to adhere firmly all round; the capsule thus becomes a hermetically sealed cartridge which can be handled freely without danger of any of the pollen being spilt or spoiled.

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[1] *I.S.J.*, 1921, 335-336.

An ordinary "blowing ball" is then obtained, and the capsule is inserted at the free end of the tube after the manner of a cork. The capsule is then pierced from end to end by a darning needle and the apparatus is ready for use. When the ball is pressed a delicate cloud of pollen is seen to emerge from the aperture at the end of the capsule and this is directed on to the receptive stigmas of the female parent, exactly simulating the process of pollination obtaining in nature. As the valve of the blowing ball prevents any back draught, the tube remains free from pollen, but it can easily be washed through after each operation if desired. After this, another capsule may be inserted and the process repeated any number of times.

It is obviously necessary that the pollen used shall be perfectly dry, and it is usually advisable to work the apparatus in dry, clear weather, because the capsules become soft under very damp conditions. To ensure effective action of the pollen its viability should always be tested. The artificial germination of sugar cane pollen presents many difficulties, but, after long continued experiments, it has been determined that the stigmas of *Datura fastuosa* var. *alba* present an excellent medium for the protrusion of the pollen tubes in healthy pollen. As a result of observation it has been possible to maintain the viability of sugar cane pollen for a week if the anthers are prevented from opening.

MONTHLY NOTES ON GRUBS AND OTHER SUGAR CANE PESTS (4th Series), 1920-21. *F. J. Illingworth. Bureau of Sugar Experiment Stations, Queensland, Division of Entomology, Bulletin No. 15, Brisbane.*

This annual collection of the typed monthly notes for the period contains a mass of observations on various forms of white grub, together with the following other sugar cane pests in Queensland :—Beetle borer (*Rhabdocnemis obscura*), linear bug (*Phaenacantha australica*), cut worms (*Cirphis unipuncta*), grasshoppers (*Locusta australis*), moth borer (*Phragmatiphila truncata*), and termites (*Mastotermes darwiniensis*). The bulletin is illustrated by plates showing the destruction caused by the grub in the falling of well grown canes, and by grasshoppers and termites.

THE RHIZOCTONIAS OF PORTO RICO. *Julius Matz. Journal of the Department of Agriculture of Porto Rico. Vol. V, No. I, January, 1921.*

This is a highly technical paper describing some of the many Rhizoctonias to be found on the crops of Porto Rico. These fungi appear to be present in great numbers, attacking parts both in the soil and above ground, and members of both series have been met with in the sugar cane. It is difficult to estimate the damage they do, but there is every likelihood that they have a distinct retarding effect on the growth of the affected plants. The fact that some of them are able to attack and destroy the root ends of the sugar cane in the field has only recently been satisfactorily determined. Without attempting to make a thorough collection of all the numerous varieties, the author investigated as many as 44 strains, which he isolated and kept in culture for some time. By a series of transfers of sclerotia and mycelia he determined that some of these were duplicates, and the number was reduced accordingly. In this reduction he appears to have relied on morphological characters and ignored the possibility of some being merely physiological varieties (that is, although being exactly similar in appearance and development differing in their preference for special hosts, etc.). Nine species are described in the paper, out of which one aërial and three terrestrial were found on sugar cane. In the former series, *Rhizoctonia grisea* (formerly recorded by KRUGER in Java in 1897) attacks the sugar cane above ground; while among the soil forms *Rh. solani*, *paluda*, and *ferrugena* were obtained, among other sources, from sugar cane roots. The paper is well illustrated with photographs of cultures of agar plates and in test tubes, and has some striking pictures in relief of the branching habit of certain species.

C. A. B.

Fifty Years Ago.

From the "Sugar Cane," February, 1872.

This issue of our predecessor contained an article on the apparatus in use at the time for the evaporation of cane juice, the "concretor," Jamaica train, Aspinall pan, the Wetzel pan, and the Gadesden pan being discussed in some detail, while the merits of heating by fire and steam were compared. Some of these comments make curious reading at the present time. "Still steam pans do possess very considerable advantages over those heated by open fire. In the first place, the proportion of heating surface to the contents of the pan can be very largely increased; not only can the pan be steam-jacketed (the steam-jacket representing the whole surface which could be heated by direct fire), but a great quantity of heating surface may be introduced into the interior of the pan, either in the form of coils of steam pipe or in some other convenient way. This increase in the proportion of heating surface to the contents means (supposing the steam to be of sufficiently high temperature) that the juice will be more quickly concentrated; in other words, that it will be exposed to heat for less time, and, therefore, less injured than in an open pan. The burning and charring of sugar, which so frequently takes place in the Jamaica train while the tayche is being emptied and the contents of one copper transferred to another, is entirely avoided . . . ."

A translation of an official paper on the analysis of sugars and molasses, drawn up by a Committee appointed by the Association des Chimistes de Sucrerie de France, was published in this issue. The determination of uncrystallizable sugar was said to be a "very delicate operation . . . the general method given in the chemical books producing only uncertain results." The process here described was a volumetric one, in which a 20 per cent. solution of sugar was run into 1 c.c. of Violette's solution while boiling, the excess of copper being tested on a glass plate with a saturated solution of potassium ferrocyanide acidified with acetic acid. It was pointed out that basic lead acetate should not be used for the clarification of the solution of sugar serving for the glucose assay, since "the sub-acetate of lead exercises an action on uncrystallizable sugar, even in the cold."

The name of C. HAUGHTON GILL is well known in connexion with his observation that the rotation of invert sugar is decreased with increasing amounts of basic lead acetate, a dextro-rotatory reading being ultimately obtained. This chemist, in 1872, delivered the Cantor Lectures on the manufacture and refining of sugar before the Society of Arts, London, the first of these lectures being reported in this issue of the *Sugar Cane*. Experiments on the diffusion of juice were demonstrated and discussed. "If then we cut up a sugar cane or beetroot into slices of a convenient size, and immerse them in water, the sugar which is a crystalloid, and the saline particles of the juice, pass out into the water beyond, while the gummy bodies to a great extent remain behind; whereas when we rasp up the plant and squeeze out the juice we get in it the whole constituents, colloid and crystalloid together. Theoretically, therefore, the diffusion process is preferable to the other . . . ."

Influence of Colloids on the Viscosity of Java Cane Molasses.[1]

By W. D. HELDERMAN and V. KHAINOVSKY.

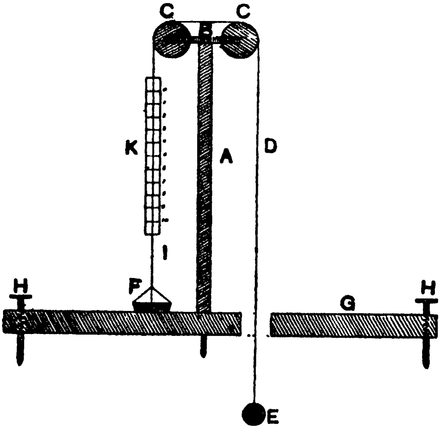
INTRODUCTION.

A systematic investigation of the influence of colloids on the properties of juice, syrups, molasses, etc., was put in hand some time ago in the Chemical Department of the Experiment Station. Owing to its novelty, and to our comparatively small knowledge of the nature of colloids, this investigation proved somewhat difficult and tedious. Nevertheless, it has given the promise of yielding some very important results.

Molasses has been chosen as the material for the research; and the property which has been selected for examination is its viscosity, one of great importance to the manufacturer, since it is intimately connected with the exhaustion of the product. In the first place, it determines for the greater part the ease of operation of the centrifuging of the molasses massecuite, placing a limit on the Brix to which a given molasses can be thickened. In the second place, the extent and the rapidity of the crystallization, and thus also the size of the grain, are most closely connected with the degree of viscosity. These reasons are important enough to justify an examination into the relation between the colloid content and the viscosity of molasses.

DESCRIPTION OF APPARATUS USED.

It was necessary to construct an apparatus capable of measuring the viscosity of the molasses with sufficient accuracy and reproducibility. Engler's viscometer, in which the rate of flow of a determined quantity of liquid through a narrow opening is ascertained, proved unsuitable for the purpose. In the first place, this apparatus yielded no absolute values by which the viscosity values could be compared one with another; while, in the second place, minute solid particles (of which there are always some present in molasses) exerted great influence on the results by obstructing the opening and thus making the determinations very unreliable.



In Arndt's so-called "fall apparatus"[2] we believe that we have found a means complying sufficiently with our demands. Fig. 1 shows a sketch of this viscometer, as used by us in a slightly modified form. Two small pulleys *C* and C' (11 mm. in diam.), revolving round hard-steel axles in agate holes, are fixed to a brass upright *A* by means of the cross-beam *B*. Over these pulleys runs a thread *D*, to which are attached a small brass ball *E* (about 7 mm. in diam.) and a small pan *F* for holding counter-weights, this scale *F* being held by a suitable device to the copper plate *G*, which can be water-levelled by means of the screws *H*. Behind the thread *D* a dividing scale *K* is provided; while by means of a mark *I* the distance of the fall of the ball *E* can be noted, the time necessary to run past this scale being ascertained by means of a chronometer.

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[1] Editorial translation (abridged) of a contribution published by the Java Experiment Station, Chemical Department, in the *Archief*, 1921, 1229-1235, 1344-1347.

[2] *Zeitsch. fur Electrochemie*, 1907, 13, 578.

METHOD OF OPERATING THE APPARATUS.

This instrument is placed above a thermostat in which a fairly wide cylinder containing the liquid under examination is placed; and if the influence of the temperature on the viscosity is very considerable, this thermostat must be held constant within ± 0·1°C. The level of the liquid is so regulated that the small ball *E* is properly immersed. One places on the small pan *F* so many weights that only a slight excess weight remains on the side of *E*, the result being that when the device holding *F* is released, the ball falls with a uniform movement. Then by means of a chronometer, one measures the time necessary for the small ball to fall a distance of say 10 cm., while the excess weight is varied by a small amount (0·1 or 0·2 and in some cases 0·02 grm.).

Since the time of the fall is conversely proportional to the excess weight (in other words, the product of the time of the fall z and the excess weight $x + a$ is constant), a series of equations can be constructed from which the first excess weight x is calculated, without it being necessary to know the sp. gr. of the liquid. Then the average of the values of x found is used for the calculation of the fall product $p = x\,(x + a)$, which also must be constant.

If we have also the "constant" of the apparatus, that is, the factor by which p must be multiplied in order to find the viscosity in absolute units, this will give all the data necessary. This constant k is found by determining the fall product p for a liquid the viscosity of which is known. If, for example, one finds a fall product α for a viscosity β at a certain temperature, then the constant is $k = \alpha/\beta$.

An example will illustrate this. In determining the constant k of our apparatus at 31°C., the following excess weights and times were noted for a fall of 10 cm. in the case of castor oil:

EXCESS WEIGHTS, GRMS.		TIMES OF FALL, MINUTES.
x	....	20
$x + 0{\cdot}02$	....	$14\frac{4}{5}$
$x + 0{\cdot}04$	....	12
$x + 0{\cdot}06$	....	10

From which figures the following equations are constructed:—

$$
\begin{aligned}
x \times 20 &= (x + 0{\cdot}02)\ 14{\cdot}8 \\
x \times 20 &= (x + 0{\cdot}04)\ 12 \\
x \times 20 &= (x + 0{\cdot}06)\ 10 \\
(x + 0{\cdot}2)\ 14{\cdot}8 &= (x + 0{\cdot}04)\ 12 \\
(x + 0{\cdot}2)\ 14{\cdot}8 &= (x + 0{\cdot}06)\ 10 \\
(x + 0{\cdot}4)\ 12 &= (x + 0{\cdot}06)\ 10
\end{aligned}
$$

And on solving x, the following values are obtained:—0·057; 0·060; 0·060; 0·062; 0·063 and 0·060, an average of 0·06. For the fall product the following values are obtained:—

$$
\begin{aligned}
p1 &= 20 \times 0{\cdot}06 = 1{\cdot}200 \\
p2 &= 14{\cdot}8\ (0{\cdot}06 + 0{\cdot}02) = 1{\cdot}184 \\
p3 &= 12\ (0{\cdot}06 + 0{\cdot}04) = 1{\cdot}200 \\
p4 &= 10\ (0{\cdot}06 + 0{\cdot}06) = 1{\cdot}200,
\end{aligned}
$$

the average of these values for p being 1·195.

By means of Ostwald's viscometer the viscosity of castor oil was found at 31° to be 3·95; so that the constant becomes $k = 3{\cdot}95/1{\cdot}195 = 3{\cdot}306$. In this manner the constant of the apparatus was determined at different temperatures.

EXPERIMENTS WITH MOLASSES.

The grain content of the original molasses taken for the experiments was determined; and following this sufficient water was added just to dissolve the grain. Solution of the crystals having thus been effected (and always confirmed microscopically), it was necessary to be certain that the molasses was saturated and completely in equilibrium. Therefore, a quantity of very large sucrose crystals were added and the molasses stirred during a few days at the temperature of examination until the refraction was constant, the molasses then being passed through very fine bronze gauze and freed from air. After carrying out a complete analysis of the sample of molasses thus prepared, its viscosity was determined.

A portion of the molasses thus treated was diluted with 4–5 times its weight of water, and mixed with the adsorption material (e.g., "Norit," infusorial earth or kieselguhr, etc.) at 60°C., drawn through a Buchner funnel and evaporated *in vacuo* below 40°C. to its original Brix. The viscosity of the molasses thus obtained was determined (after elimination of the air) at the same temperature as before. Lastly, a portion was analysed. In this way it was possible to carry out the various measurements with grain-free yet saturated molasses.

RESULTS OBTAINED.

In the following tables the results of the viscosity determinations, together with the analyses, are recorded:—

Table I.

DEFECATION MOLASSES.

	No. 1. Original sample.	No. 2. Treated with 17·6 per cent. of infusorial earth.	No. 3. Treated with 17·6 per cent. of "Norit."
Brix (picnometer)	81·01	81·20	81·08
Brix (refractometer)	80·32	81·08	78·56
Gums and pectins	1·34	0·91	0·73
Sulphated ash	10·34	7·74	7·85
Sucrose	32·40	34·38	31·49
Reducing sugars	22·32	23·34	26·94
Purity	40·0	42·3	38·8
Viscosity, 30 per cent.	57·95	37·59	32·63

DEFECATION-SULPHITATION MOLASSES.

	No. 4. Original sample.	No. 5. Treated with 15·9 per cent. of infusorial earth.	No. 6. Treated with 7·95 per cent. of "Norit."
Brix (picnometer)	81·25	81·35	81·41
Brix (refractometer)	78·65	78·20	77·81
Gums and pectins	0·77	0·54	0·53
Sulphated ash	8·64	8·20	8·23
Sucrose	35·94	35·94	36·55
Reducing sugars	21·21	20·74	22·86
Purity	44·2	44·1	44·9
Viscosity, 30 per cent.	26·19	13·99	20·94

CARBONATATION MOLASSES.

	No. 7. Original sample.	No. 8. Treated with 17·4 per cent. of infusorial earth.	No. 9. Treated with 11 per cent. of "Nori ."
Brix (picnometer)..	84·62	84·84	84·52
Brix (refractometer)..	81·85	80·42	79·81
Gums and pectins..	0·49	0·43	0·32
Sulphated ash	10·52	11·02*	10·31
Sucrose	27·59	28·27	26·25
Reducing sugars	32·20	29·18	29·47
Purity	32·60	33·4	31·1
Viscosity, 30 per cent.	58·80	33·18	33·50

DISCUSSION OF RESULTS.

In all the cases examined a strong diminution of the viscosity could be detected owing to treatment with adsorption material, amounting to about 47 per cent. of the original value in the most favourable instance. It further appears that "Norit" in general exerts a more favourable effect than does infusorial earth. Although it is only relatively small, the content of gums and pectins was throughout reduced, as was also the ash content. The variations in the purity were sometimes positive and sometimes negative, thus leading to no definite conclusion regarding this figure.

In general it follows from the investigation that the colloids present in molasses exert a very great influence on the viscosity and on other properties. If adsorption materials are to be applied in practice, they must be added, not to the molasses, but to the thin and (or) thick juice. Working in this manner in the laboratory, we found it possible to obtain a thin juice which under the ultramicroscope appeared to be absolutely colloid-free. However, the necessary amount of "Norit" (2–3 per cent. of the raw juice) is too much for practical application so long as no simple and economical method of revivifying this material remains undiscovered. If such a method were found, the application of "Norit" or other such preparation would have as its result the diminution of the viscosity of the massecuite, while the removal of non-sugar would mean a greater yield of sugar.

Table II.

	DEFECATION.			SULPHITATION.	CARBONATATION.		
	1. Grain-free, saturated.	2. With 17·6 per cent. of infusorial earth.	3. With 17·6 per cent. of "Norit."	4. With 7·95 per cent. of "Norit."	5. Grain-free, saturated	6. With 17·4 per cent of infusorial earth.	7. With 11 per cent. of "Norit."
Number of colloid particles per 1 c. mm. in millions	5·11	0·36	4·93	0·25	2·44	0·39	0·56
Particles remaining, per cent.	100%	7·0% of No. 1	96·3% of No. 1	4·9% of No. 1	47·8% of No. 1	15·9% of No. 5	22·8% of No. 5
Particles adsorbed, per cent...	—	93·0% of No. 1	3·7% of No. 1	95·1% of No. 1	52·2% of No. 1	84·1% of No. 5	77·2% of No. 5
Viscosity at 30°C.....	57·95	37·59	32·63	20·94	58·8	33·18	33·5

ENUMERATION OF THE COLLOID PARTICLES.

Table II gives the number of the colloid particles per unit volume, together with the corresponding viscosity numbers. Regarding the method used, each sample of molasses was diluted with nine parts of water, and filtered, first through ordinary and then through hardened filter-paper. The enumeration was carried out with a slit ultra-microscope, making it possible to produce a ray of light from which micrometrically one measurement could be made. The second and third dimensions of the volume were obtained by using diaphragms of different optical areas. The volumes were always so chosen that at most five particles were present in the field of vision, while for each determination a great number of counts were made.

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* Some infusorial earth passed into the filtered molasses in this determination, and so into the ash.

From the results shown in Table II it follows: (1) That in all cases the quantity of colloids was diminished by the treatment with adsorption material. (2) That in molasses Nos. 3 and 7 relatively many colloid particles were present after treatment. Where by treatment with "Norit" the viscosity had been very greatly diminished, we think this may be explained by the view that "Norit" removes the emulsoid colloids (which exert a great influence on the viscosity), itself dissolving either partly as a suspensoid, or else giving rise in some way or another to suspensoid colloids.[1] This view finds support from the following experiment: A 30 per cent. solution of pure sugar was shaken with 10 per cent. of "Norit" and filtered first through ordinary and then through hardened filter-paper. In the second filtrate, 0·35 million colloid particles per c. mm. could be counted. (3) That the number of colloid particles in the carbonatation molasses in their original state appears to be only about one-half that in the defecation molasses.

COLORIMETRIC EXAMINATION.

The molasses samples were diluted 1:100, filtered through ordinary and then through hardened filter-paper, the second filtrate being compared in the colorimeter with a solution of caramel corresponding in colour with the filtered carbonatation molasses No. 5. However, the colour of the defecation molasses differed in tint from that of the standard solution, making the comparison difficult and therefore less accurate. The results are shown in Table III.

Table III.

	DEFECATION.			SULPHITATION.	CARBONATATION.		
	1. Grain-free, saturated.	2. With 17·6 per cent of infusorial earth.	3. With 17·6 per cent. of "Norit."	4. With 7·95 per cent. of "Norit."	5. Grain-free, saturated.	6. With 17·4 per cent. of infusorial earth.	7. With 11 per cent. of "Norit."
Standard caramel solution, in c.c., equal in colour to 1 c.c. of 1 per cent. molasses	3·91	3·58	1·06	0·7	1·0	0·44	0·64
Colouring substances remaining, per cent.	100%	91·6% of No. 1	27·1% of No. 1	17·9% of No. 1	25·6% of No. 1	44% of No. 5	64% of No. 5
Colouring substances adsorbed, per cent.	—	8·4% of No. 1	72·9% of No. 1	82·1% of No. 1	74·4% of No. 1	56% of No. 5	36% of No. 5

In all cases the content in colouring substances was considerably lowered by the treatment with adsorbing material, though in a very differing degree (8·4 to 92·9 per cent.). "Norit" decolorizes better than infusorial earth under the conditions obtaining. Carbonatation molasses appears to have about one-quarter of the colour of the defecation molasses, which in addition to caramel contains other more intensely yellow substances.

Finally, general microscopic and macroscopic observations of the diluted as well as of the undiluted molasses were made.[2] One point only regarding these need be put forward, namely, that crystals settled out in all the molasses, after treating with the adsorbing material and concentrating to the original Brix. These crystals are very probably calcium salts, which before treatment were held in solution by some protective colloid or another, flocculating and crystallizing out when this protective colloid was removed.

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[1] Suspensoids exert only a slight influence on the viscosity of the dispersion medium.

[2] The table summarizing these need not be reproduced here.—ED., *I.S.J.*

India.

Sugar Imports during the last Three Years.[1]

Sugar.—Sugar is second only to piece goods in the import trade of India, and the imports last year of raw sugar, of 16 D.S. and above, were valued at £16,945,867. These imports for the last three years were as follows:—

COUNTRY OF ORIGIN.	1918-19. TONS.	1919 20. TONS.	1920-21. TONS.
Straits Settlements	62,130	18,144	8,935
Java	363,074	349,266	201,109
China	2,888	12,090	5,926
Egypt	853	3,305	4,188
Mauritius and Dependencies	77,180	23,486	11,487
Total imports	506,680	408,375	236,184
Total values in £ (1000)	10,245	21,826	16,946

The average declared value of the sugar (16 D.S. and above) in the year 1919-20 was Rs. 26.11.8 per cwt. It is interesting to observe that, in 1920-21, 1765 tons of beet sugar were imported into Karachi from Central Europe.

Other imports of sugar were as follows:—

ARTICLE.	1918-19. £	1919-20. £	1920-21. £
Sugar (15 D.S. and below)	68	15,693	42,021
Molasses	125,450	893,853	1,047,362
Confectionery	37,207	212,504	393,581

The imports of molasses are nearly all drawn from Java.

Confectionery.—It is in confectionery, however, that British manufacturers have the greatest interest and supply the bulk of the trade. The provenance of the imports in 1919-20 was as follows:—

	£
From the United Kingdom	152,444
,, the United States	31,616
,, Japan	16,490
,, Holland	5,589
Trade imports	212,504

The demand in India for sweets of all kinds is almost insatiable. Owing to the frugal, vegetarian diet of the greater part of the population, sugar is required in large quantities to maintain strength. The great demand is met by native preparations, and there are also one or two modern factories in Madras and elsewhere for the manufacture of sweets on a large scale. Imports are likely to increase, and the United Kingdom should maintain her position if our manufacturers only insist on efficient representation. The United States is competing more and more in chocolates and the best quality sweetmeats. Japan contributes the cheaper productions from sugar.

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[1] Department of Overseas Trade Report, October, 1921.

Correspondence.

MILL EXTRACTION FORMULÆ.

To the Editor, "The International Sugar Journal."

Sir,—In reply to Mr. Noël Deerr's letter, appearing in your issue for December, I would first say that I regret having so phrased some of my remarks as perhaps to appear unfair to Mr. Deerr, which was by no means my intention. As Mr. Deerr remarks, my article was only in part a reply to his, and was, to a great extent, intended to offer for consideration or criticism the method adopted for obtaining my formulæ, which originally had to be omitted, owing to war-time limitations of space, but, lacking which, the formulæ lose considerably in value.

For the fibre contents of bagasse, I usually allow for 37 and 42 per cent. from the first two mills (with crusher), and 47 per cent. from all later mills: I think the 37 is rather high for the first mill of a long train working at full capacity, and probably 33 per cent. would be nearer. Of course better figures than these are obtained at a number of factories, but I think they are quite good to use for ordinary purposes, and in the absence of special information.

Regarding the application of milling formulæ to diffusion batteries, it depends on the method of working the latter. If a battery is worked by filling up, standing, and running off, then the milling formulæ are applicable; if the juice flow is continuous during a cycle, which should theoretically give better results, then they are not applicable.

With reference to the algebraic solution supplied to Mr. Deerr by Mr. L. Wachenberg and appearing in "Cane Sugar" (1921 edition), I am sorry to have to point out that it does not appear to be more correct than was Mr. Deerr's formula of 1917, and that it soon leads to impossible results. For example, on p. 237 of "Cane Sugar," the table gives an extraction of 0·968 for quadruple compound imbibition of 10 per cent. on cane of 15 per cent. fibre, all bagasse being crushed to 60 per cent. fibre. Now, the total normal juice in the cane is 0·85, and the total mixed juice is 0·95, of which 0·80 is expressed and 0·15 remains in the final bagasse; the extracted mixed juice is therefore 80/85 = 0·9412 of the original normal juice in the cane, and as its Brix is less, the extraction is certainly less than 0·941, and the tabulated figure of 0·968 is much too high.

It is only fair to check over the tabular figure from the formula, to verify that it is not merely a case of a numerical error. We have, for $f = 0{\cdot}15$, $w = 0{\cdot}1$, and $m = 0{\cdot}5$, the recovery ratio $r = 0{\cdot}4$, and the extraction will be

$$\frac{0{\cdot}70 + \dfrac{0{\cdot}4 \times 0{\cdot}15}{0{\cdot}4 \times 0{\cdot}6^4}}{0{\cdot}85} = 0{\cdot}9568,$$

instead of the 0·968 tabulated. This shows a numerical slip, but the corrected figure is no better, and is beyond all possibilities. The figures given in "Cane Sugar" for 15 per cent. fibre cane with 10 per cent. imbibition, the same carefully re-calculated, and the corresponding figures given by my formula, are as follows:—

No. of wet crushings.	Deerr. Given.	Deerr. Re-calculated.	Parr.
0	0·823	0·8235	0·8235
1	0·893	0·8941	0·8941
2	0·916	0·9164	0·9164
3	0·952	0·9381	0·9267
4	0·968	0·9568	0·9323
∞	—	1·0000	0·9412

from which it will be seen that the figures up to two wet crushings are in accord, but that for more, the extraction given by the Deerr-Wachenberg formula is too great.

Next, we may note that the formula given by Mr. Deerr would give unit (100 per cent.) extraction from an unlimited train of mills, no matter what the quantity of imbibition water, for r is necessarily a positive proper fraction, and so therefore is $1 - r$, and thus $(1 - r)^n$ becomes infinitely small as n becomes infinitely great, leaving $r/r = 1$ as the extraction in all cases. But it is easy to see that complete extraction is not possible if the imbibition water supplied is less than the residual juice in the dry-crushed bagasse, or if $< 0{\cdot}5$, for the juice expressed is equal in quantity to the water supplied, and its Brix approximates to that of the normal juice as the number of mills is increased, but can never exceed the latter, no matter how many mills are in the train. We thus see, from first principles, that if $r < 0{\cdot}5$, then the limiting extraction with an unlimited train of mills is $\dfrac{\text{imbibition}}{\text{juice in dry bagasse}}$, which is $\dfrac{r}{1-r}$, and any accurate formula must reduce to this when $r < 0{\cdot}5$ and n is made infinitely great, a condition not satisfied by the DEERR-WACHENBERG formula, which we must on this account conclude to be in error.

The relation $R_n = (K^n - 1)/(K - 1)$, given on p. 566 of my article, gives, when $K < 1$ (corresponding to $r < 0{\cdot}5$) and n is infinitely great, $R = 1/(1 - K)$, and therefore gives an extraction of $1 - (1 - K)$, or K, which is $r/(1 - r)$: thus my formula stands up to this test.

Turning to p. 235 of "Cane Sugar," in the ninth line from the bottom, e_2 is twice printed instead of e_1, and the equation should read :—

$$e_1 = r\,(1 + e_2)$$

as correctly given on p. 236, line 5. The next equation, p. 235, sixth line from bottom :—

$$e_2 = r\,(1 + e_2)\,(1 - r) + e_3\,r$$

is given correctly, but is reprinted wrongly with $(1 + r)$ at the top of p. 236. The third equation, at the bottom of p. 235 :—

$$e_3 = r\,(1 + e_2)\,(1 - r)^2 + e_3\,r\,(1 - r)$$

is correct.

The desired relations can be obtained somewhat more readily thus :—

Mill No.	Enters.	Expressed.	Remains in bagasse.
1	$1 + e_2$	e_1	$1 - e_1 + e_2$
2	$1 - e_1 + e_2 + e_3$	e_2	$1 - e_1 + e_3$
3	$1 - e_1 + e_3$	e_3	$1 - e_1$

therefore :—

$$\begin{aligned} e_1 &= r\,(1 + e_2) \\ e_2 &= r\,(1 - e_1 + e_2 + e_3) \\ e_3 &= r\,(1 - e_1 + e_3) \end{aligned}$$

or :—

$$\begin{aligned} e_1 - re_2 - r &= 0 \\ re_1 + (1 - r)e_2 - re_3 - r &= 0 \\ re_1 + (1 - r)e_3 - r &= 0 \end{aligned}$$

The solutions I get for e_1 and e_2 in terms of r, from either of these equivalent sets of equations, are :—

$$e_2 = \frac{r - r^2}{1 - 2r + 2r^2} \qquad e_1 = \frac{r - r^2 + r^3}{1 - 2r + 2r^2}$$

both of which are very different from the results given on p. 236 of "Cane Sugar." As I have obtained the same results from both of the above sets of equations, by following through the substitutions, and also by using determinants to shorten the work, I feel satisfied that my results are correct, and that if Mr. DEERR will carefully examine Mr. Wachenberg's algebra, he will find an error somewhere in the substitution for e_3, mentioned at the top of p. 236, but details of which are not given.

Now, asssuming, as I believe to be the case, that my formulæ are correct, then any other correct ones will be algebraical transformations of mine, and they are readily transformed to Mr. Deerr's notation. Since, as shown in my article, $E = 1 - \dfrac{1}{R}$, and $R = \dfrac{K^n - 1}{K - 1}$ we have $E = \dfrac{K^n - K}{K^n - 1}$. Now my K is Mr. Deerr's $r/(1 - r)$, and my n is Mr.

Deerr's $n+1$, so that, to agree with Mr. Deerr's notation:—

$$E = \frac{\left(\frac{r}{1-r}\right)^{n+1} - \frac{r}{1-r}}{\left(\frac{r}{1-r}\right)^{n+1} - 1}$$

and multiplying numerator and denominator by $(1-r)^{n+1}$ we have:—

$$E = \frac{r^{n+1} - r(1-r)^n}{r^{n+1} - (1-r)^{n+1}} = \frac{r\left[(1-r)^n - r^n\right]}{(1-r)^{n+1} - r^{n+1}} \quad . \; . \; . \quad (1)$$

which I believe to be the correct form of the equation with Mr. Deerr's notation. It should be noted that $1 - 2r$ is a factor of both numerator and denominator, so that if we have to deal with $r = 0{\cdot}5$, this factor must be divided out after expansion, or the numerical result will appear in the indeterminate form 0/0.

For $n = 1$, this formula gives $E = r$, which is known to be correct: for $n = 2$, it gives $E = r/(1 - r + r^2)$, as found from first principles on p. 235 of "Cane Sugar." For $n = 3$ we have:—

$$E = \frac{r(1-r)^3 - r^4}{(1-r)^4 - r^4} = \frac{r(1-2r)(1-r+r^2)}{(1-2r)(1-2r+2r^2)}$$

$$\begin{array}{c} r - r^2 + r^3 \\ \\ 1 - 2r + 2r^2 \end{array}$$

exactly the same as found above from the direct analysis for three wet mills. For an unlimited train of mills, or $n = \infty$, if $r < 0{\cdot}5$, then $1 - r > 0{\cdot}5$ and $r/(1-r) < 1$, when the equation reduces to $E = r/(1-r)$: if $r > 0{\cdot}5$, then $1 - r < 0{\cdot}5$ and $r/(1-r) > 1$, when the equation reduces to $E = 1$, both of which are correct. It would thus appear that the DEERR-WACHENBERG formula should be replaced by (1) above.

P. H. PARR.

Publications Received.

Die Sieblose Schleuder [Imperforate Drum Centrifugals]. By Berthold Block. (Otto Spamer, Leipzig.) 1921. Price: M. 78.

During recent years a great deal of work has been done in the design of centrifugals with imperforate drums for the separation of insoluble matter from liquids. Machines have been elaborated in different industries, which in many cases have been found very satisfactory, and now are in constant use; but in other industries, owing either to the nature of the precipitate, or to the nature of the liquid from which it is separated, or to both causes, the results have been less encouraging. It is with the purpose of compiling a record of this work, and of exposing the theory underlying it, that the author has written this work, the first of its kind so far as we are aware. Those interested in the subject will welcome it, by reason of the comprehensive and thorough manner in which the various aspects of centrifuging with imperforate drums are treated. There are chapters on the settling of precipitates; on centrifugal force generally; on the centrifugal drum; on the ease of separation in reference to the size of the particles; on the various designs of imperforate drum machines; on centrifugals with continuous action; and on the power consumption in the driving of centrifugals for the purpose under consideration. Among those industries in which success in the use of this type of centrifugal has not yet been achieved must be included that of beet sugar manufacture. This problem is reviewed, and it is mentioned that during the war, probably urged by the desirability of obviating the use of filter-cloth, Dr. CLAASSEN investigated the question in his usual thorough manner,[1] coming to the general conclusion in regard to the separation of the scum from the carbonated juice that centrifugals are entirely unsuitable, and further that there appears no prospect of utilizing them with technically and commercially satisfactory results. With this decided and indeed almost dogmatic opinion, Mr. BLOCK does not agree,[1] and rightly, we consider, for there are various possibilities which are capable of affecting the question; for example, a better understanding of the colloidal nature of beet juice leading to the production of a precipitate more amenable to treatment might altogether alter a problem which at present appears quite baffling.

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[1] See *Vereinszeitschrift*, 1918, 191.

The Manufacture of Chemical Manures. By J. Fritsch. Second English Edition. (Scott, Greenwood & Son, 8, Broadway, London, E.C. 4.) 1921. Price: 15s. net.

Fritsch's book was originally published in France in 1909; and an English translation was prepared in 1911 by Mr. DONALD GRANT, who added many practical notes gathered from his long experience as chemist and manager in fertilizer and sulphuric acid works. Now Mr. STOCKS has prepared a second revised and enlarged edition, and the result is a generally reliable and modern account of this important industry, useful not only to manure manufacturers, but also to farmers, agricultural chemists, and others interested in the industry of agriculture. It covers the manufacture of superphosphates, double superphosphates, bone dust, basic slag, nitrogenous manures, nitrogenized phosphatic manures, and the preparation of potassic manures. A good account of the several raw materials used is given, and also of the reactions occurring during their conversion to the finished product. Regarding the plant described in this book for use in the manufacture of fertilizers, on the whole this is fairly up-to-date, though we think that in this English edition the opportunity might have been taken to say something of the most modern machinery made by British and American firms, who for the greater part pass unmentioned, most of the illustrations bearing the names of German and a few of French firms. Nevertheless, it may be said that this is certainly a useful account of the manufacture of fertilizers, which may well be recommended to all interested in agricultural matters.

Fuel for Motor Transport: Second Memorandum by the Fuel Research Board. [Dealing *inter alia* with Power Alcohol.] (H.M. Stationery Office, Kingsway, London, W.C. 2.) 1921. Price: 6d. net.

In this Report it is stated that experiments are still being carried out in this country on the cultivation of Jerusalem artichokes; and investigations on the possibilities of producing alcohol in the Empire overseas are also still in progress. So far as these have gone, it has been concluded that molasses as a raw material would be insufficient to supply even local requirements,[2] but that alcohol might be made from suitable crops in those countries where labour is available, especially where petrol is dear, for instance in the East African Protectorates and the West African Colonies, which, moreover, are very dependent on motor transport for their development. Research is on hand to find a process for the conversion of cellulosic materials to alcohol on the commercial scale. "Until alcohol can be made from waste materials which can be collected and treated at small cost, it does not seem likely that Empire-produced alcohol can be imported into this country on any considerable scale . . . ."

Sugar Cane in St. Croix. Longfield Smith. Bulletin No. 2, Virgin Islands Agricultural Experiment Station. (Superintendent of Documents, Government Printing Office, Washington, D.C., U.S.A.) 1921. Price: 10 cents.

Contents :—Climatic conditions; soils; preparation of land; method of planting; time of planting; fertilization of cane; harvesting the crop; yield of cane; cost of growing and harvesting; varieties; pests and diseases.

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[1] A useful survey of the matter has been presented by Mr. BLOCK in the *Vereinszeitschrift*, 1918, 383.

[2] See also *I.S.J.*, 1920, 429.

Review of Current Technical Literature.[1]

MILLING [ROLLS, HYDRAULICS, RETURNER BARS, SCRAPERS, AND "MILL EFFICIENCY"]. *James Ogg*, and others. *Proceedings of the Sugar Mens' Convention, Bacolod, Occidental Negros, P.I., September, 1921.*

At the opening meeting of the Convention, Mr. JAMES OGG contributed an interesting practical paper, following the reading of which a good discussion took place. It was agreed by the engineers present that the material of which the roll is made has an important bearing on slippage and its relation to a well-regulated feed. But it was also pointed out that the problem of uniform feed has been largely solved by the use of a coarse pitch groove, and of the Messchaert juice groove. Some held that coarse grooves cannot be set as closely as fine pitch grooves; and that as a result the extraction is lower and the moisture content of the final bagasse higher. A favourite combination is the use of coarse grooves on the crusher and first mill, and fine grooves in conjunction with the Messchaert juice grooves on succeeding mills. Regarding the effect of hydraulics on milling, it was pointed out that when the hydraulic jacks are of equal bore, the pinion side of the roll rises more than the other and is sluggish in its return. A factory in Hawaii had greatly improved its milling results by installing jacks of different bore on the two sides of the roll. Often the cross-sectional area of the hydraulic pipes from accumulators to jacks is too small, causing a sluggish movement of the liquid, which prevents a sufficiently rapid response to fluctuations in the thickness of the blanket. Probably the height of the rim of the jack leather has quite a lot of influence on the speed with which the jack acts, most of the leathers put on the market having rims 1¼ in. to 1⅜ in. high, whereas some contend only ⅜ in. to ½ in. is necessary. In regard to the returner bar, it was stated that its setting is more efficient when the sweep of the blade is concentric with the top roll. It was generally agreed that the width of the opening between the returner bar and the top roll depends upon the size of the rolls and the amount of cane going through, and must be varied from time to time as conditions demand. There was considerable difference of opinion at the meeting as to whether steel or cast-iron scrapers are preferable, good points being mentioned in favour of each. Milling results are affected by various conditions, each one of which must be given due consideration before the efficiency of milling cane be justly measured. The mill getting the highest extraction is not necessarily the most efficient. Hence "mill efficiency" was adopted by the engineers present as being a more satisfactory measure of the result of milling than extraction. It is defined as the extraction calculated from the actual per cent. polarization and moisture in the bagasse, assuming the purity of the last expressed juice to be 70°, and the fibre and sucrose in the cane milled to be 11 and 13 per cent. respectively.

A NEW BASIS OF COMPARING MILLING RESULTS AND BOILING-HOUSE RECOVERIES IN RAW SUGAR FACTORIES. *Arnold H. Warren*. *Sugar News, 1921, 2, No. 12, 577-585.*

Milling Efficiency.—Extraction (sucrose in the juice per cent. sucrose in the cane) has long been recognized as not being an exact measure of the efficiency of the operation of the mill, since it is so greatly affected by the sucrose and fibre in the cane, and to some extent by the purity of the last mill juice, none of which factors is within the control of the factory. Thus, let it be assumed in a certain mill that only the sucrose in the cane varies, the fibre in the cane being constant at 11, the purity of the last mill juice at 70°, the sucrose in the bagasse at 2, and the moisture in the bagasse at 47 per cent. Then when the sucrose in the cane is 10, 12, 15, 16 per cent. the extraction will be 95·61; 96·34; 97·07; 97·26 per cent. respectively. Similarly, if the fibre in the cane be the only varying factor, there will result a considerable decrease in the extraction with the increase of the fibre; while again if the purity of the last expressed juice be varied (and all the other factors retained constant) there will still be an effect on the extraction, though in this case the influence of this variation is much less than in the case of the other two factors mentioned. Mr. E. W. KOPKE has therefore suggested, in order to eliminate the influence of these fluctuations in the extraction due solely to variations in the quality of the cane ground, and not to the increase or decrease of the efficiency of the milling itself, that the actual sucrose and moisture per cent. of the bagasse be taken as found, and the extraction calculated with the assumption that the following are constants: sucrose in the cane, 13; fibre in the cane, 11; and purity of the last mill juice, 70°. "Mill efficiency" would be the term given the extraction figure thus calculated; and by means of it one should be able to compare milling results in different factories and in the same factory on different days, thus ascertaining when a mill is actually doing its best work. Several objections might be raised to this method, and one of these is that many factors affecting mill work, such as the number of rolls, tons of cane ground per hour, the surface speed of the rolls, and the amount of maceration water, are all disregarded. But in reply to this it is pointed out that it is not desirable to involve such factors in a determination of mill efficiency, because they should be within the control of the factory itself.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*)

Boiling-House Efficiency.—Just as extraction alone is not an exact measure of the milling efficiency, so the *s j m* recovery as ordinarily calculated is not a just indication of the b.h. efficiency. For the boiling-house recovery is limited on the one hand by the commercial necessity of making a high purity sugar, and on the other hand by the purity of the syrup derived from the cane, neither of which factors is within the control of the factory. There are three factors involved in the calculation of the boiling-house recovery by the *s j m* formula, and two of these, namely the purity of the syrup and that of the sugar, are not within the control of the factory. Therefore, it is proposed by Mr. KOPKE in this calculation also that the variable factors should be replaced by constants, *s* being 97·5, and *j* 85·0, and that the ratio between the boiling-house recovery for 30° gravity purity molasses and that for the actual gravity purity of the molasses be calculated. Thus the formula for the calculation of what is termed the boiling-house efficiency

$$\text{becomes}: = \frac{\dfrac{97\cdot5\ (85\cdot0-\mathrm{M})}{85\cdot0\ (97\cdot5\ \mathrm{M})}}{\dfrac{97\cdot5\ (85\cdot0-30\cdot0)}{85\ 0\ (97\cdot5-30\cdot0)}} \times 100.$$

Then the general factory efficiency = mill efficiency × boiling-house efficiency.

DETERIORATION OF CANE AFTER CUTTING. *Raymond Elliott.* *Report made to the Hawaiian Chemists' Association, November, 1920.*

Mr. ELLIOTT, Chairman of the Committee on Deterioration of Cane after Cutting, appointed by the Hawaiian Chemists' Association, reported the results of 23 tests conducted on four plantations. He found that the cane loses weight from the time it is cut until it is ground, although the conditions vary. When the weather is hot, and when there is a breeze, the loss in weight reaches a maximum; whereas when the air is saturated with moisture, and there is no wind, the loss is lessened. Burnt cane deteriorates faster than unburnt under practically the same conditions. Thus, in five tests made in three districts with Yellow Caledonia variety, the tests gave the following figures indicating the loss per cent. during different periods:—

	DAYS AFTER CUTTING.							
	1	2	3	4	5	6	7	8
Burnt	3·80	8·88	9·67	12·43	8·63	19·00	16·12	23·82
Unburnt	2·52	5·67	6·49	14·28	14·43	17·39	17·37	20·56

In some cases the results of the individual tests were erratic, and this was believed to be due to the methods of sampling. Rather large samples must be taken to obtain concordant results. Each bundle of cane should weigh at least 75–100 lbs., and contain 40 or more sticks, which should be taken in consecutive order in the line; while instead of running samples every day, it seems better to do so every two days, interpolating the results.

Review of Current Technical Literature.

Revision of the Double Polarization Method of determining Sucrose and Raffinose.

C. A. Browne and C. A. Gamble. Journal of Industrial and Engineering Chemistry, 1921, 13, No. 9, 793–797.

Herzfeld's modification of Creydt's formulæ, namely, $S = \frac{0{\cdot}5124\,P - P'}{0{\cdot}839}$ and $R = \frac{0{\cdot}3266\,P + P'}{1{\cdot}554}$, in which S and R are respectively the sucrose and raffinose content, and P and P' the direct and inversion readings at 20°C., is based on the Herzfeld divisor of 132·66; but during recent years several workers, e.g., Langguth, Steuerwald[1] and Schrefeld,[2] among others, have found the divisor to be 133·0, which value is corroborated also by the authors. This new divisor necessitates the revision of the method of calculating raffinose by means of these formulæ. In effecting this revision, hydrolysis of the raffinose was effected by Schrefeld's modification, according to which 50 c.c. of the solution were mixed with 25 c.c. of water and 5 c.c. of hydrochloric acid (sp. gr., 1·19) in 100 c.c. flasks, which were immersed in a large water-bath at 70°C., the temperature reaching 67°C. in 3 mins., after which heating was continued for 5 mins. longer, the contents of the flasks cooled, made up to 100 c.c. and polarized at 20°C. Then the ratio of the direct to the inversion polarizations was found to average 0·514, as compared with 0·5124, the value used in the Herzfeld formula. Accepting the inversion factors of $-\,0{\cdot}33$ and $+\,0{\cdot}514$ for sucrose and raffinose respectively, the formulæ become: $S = \frac{0{\cdot}514\,P - P'}{0{\cdot}844}$, and $R = \frac{0{\cdot}33\,P - P'}{1{\cdot}563}$ all the readings being taken at 20°C. When the readings are taken at other than 20°C., the temperature correction formula for the direct reading in the case of sucrose is: $P = S\,[1 - 0{\cdot}0003\,(T - 20)\,] = S\,(1{\cdot}006 - 0{\cdot}0003T)$; and that for the invert reading: $P' = S\,[-\,0{\cdot}33 + 0{\cdot}005\,(t - 20)\,] = S\,(-\,0{\cdot}43 + 0{\cdot}005t)$, T being the temperature of the direct and t of the invert polarizations. In the case of raffinose before inversion, the polarization decreases with increase of temperature at the rate of 0·00034°S. for 1°C., thus approximating to the value for sucrose (which is 0·00030). Therefore, the equation representing the direct polarization at temperature T of a sucrose normal weight of product containing S per cent. of sucrose and R per cent. of raffinose becomes: $S\,(1{\cdot}006 - 0{\cdot}0003\,T) + 1{\cdot}852\,R\,(1{\cdot}006 - 0{\cdot}0003\,T)$. Raffinose after inversion was found to decrease in rotation at the rate of 0·018°S. for 1°C., making the temperature correction formula: $+\,51{\cdot}4 + 0{\cdot}18\,(t - 20) = +\,47{\cdot}8 + 0{\cdot}18\,t$. Then, in place of the formula expressing the invert polarization of a sucrose normal weight of product containing S per cent. of sucrose and R of raffinose: $P' = -\,0{\cdot}33\,S + (1{\cdot}852\,R \times 0{\cdot}514)$ for 20°C., we have $P' = S\,(-\,0{\cdot}43 + 0{\cdot}005\,t) + 1{\cdot}852\,R\,(+\,0{\cdot}478 + 0{\cdot}0018\,t)$ for t°C. This finally gives the following formulæ for the sucrose and raffinose contents:

$$S = \frac{P(0{\cdot}478 \times 0{\cdot}0018t) - P'(1{\cdot}006 - 0{\cdot}0003T)}{(0{\cdot}908 - 0{\cdot}0032t)\,(1{\cdot}006 - 0{\cdot}0003\,T)} \qquad R = \frac{P(0\,43 - 0{\cdot}005\,t) + P'(1{\cdot}006 - 0\,0003T)}{(1{\cdot}681 - 0{\cdot}0059\,t)\,(1{\cdot}006 - 0{\cdot}0003\,T)}$$

And when T and t, the temperatures of the direct and invert polarizations are each 20°C., these two equations are the same as above stated: $S = \frac{0{\cdot}514\,P - I}{0{\cdot}844}$ and $R = \frac{0{\cdot}33\,P + P'}{1{\cdot}563}$. With mixtures containing less sucrose than 13 grms. per 100 c.c., the divisor 133 requires modification for the change in concentration. In the analysis of beet molasses, the question of the influence of the impurities upon the degree of accuracy must be considered. In the case of the optically-inactive salts, as potassium and sodium oxalate, the authors conclude from their experiments that their influence on the rotation of sucrose and raffinose is small, and does not produce an error exceeding 0·1 or 0·2 per cent. in regard to such amounts as occur in beet molasses. Optically-active amino compounds increase their rotation to a marked degree in the presence of hydrochloric acid, the result being a pronounced diminution in the calculated sucrose per cent., and a pronounced increase in the raffinose, or in other words, the presence of raffinose may be indicated when it is entirely absent. Then there is the influence of the basic lead acetate used for clarification. Due to the volume of the lead precipitate, the sucrose and raffinose contents are both increased as the result of the concentration. Basic lead acetate remaining in solution decreases the polarization of sucrose and raffinose, and causes the polarization of asparagin and aspartic acid to deviate strongly to the right, and those of glutamin and glutamic acid to go slightly to the left. However, it is concluded that "the sum of all the influences of basic lead acetate upon the errors of the optical method for analysing sucrose-raffinose mixtures would seem generally to be compensating, the errors being usually less with than without its use," as shown in the following table, which gives a general summary of the results obtained in the analysis of mixtures of sucrose and raffinose containing potassium oxalate and asparagin in the presence and absence of basic lead acetate:—

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[1] *I.S.J.*, 1914, 82-83. [2] *I.S.J.*, 1921, 225.

	TAKEN					OBSERVED		CALCULATED	
No.	Sucrose Per cent.	Raffinose Per cent.	Potassium Oxalate Per cent.	Asparagin Per cent.	Basic Lead Acetate	*P*	*P′*	Sucrose	Raffinose
1	50·00	9·25	—	—	—	+67·13	—7·55	50·06	9·21
2	50·00	9·25	11·54	—	—	+66·95	—7·57	49·98	9·16
3	50·00	9·25	—	3·85	—	+66·78	—5·85	47·83	10·23
4	50·00	9·25	11·54	3·85	—	+66·80	—5·90	47·89	10·20
5	50·00	9·25	11·54	3·85	10 c.c.	+67·18	—6·20	48·49	10·09

ALCOHOL MOTOR FUEL IN AUSTRALIA. *J. Brownlie Henderson. Australian Sugar Journal, 1921, 13, No. 8, 458–467.*

In a lecture delivered at the Automobile Club of Queensland, the author[1] stated that there is no question whatever that alcohol can in certain districts be made from waste molasses, and sold at a profit at 2s. per gallon, the present price of petrol being 3s. Since, however, the quantity of molasses available is limited, it is necessary to consider the cultivation of crops capable of yielding sugar or starch for conversion into spirit, and the most promising of these seems to be the sweet potato. With careful cultivation it should give at least 20 tons per acre, and the cost of production should not exceed £15 per acre, with overhead charges and profits. One ton should yield about 35 gallons of spirit, and the cost of the raw material per gallon of alcohol would be 7d., making the cost of production less than 1s. Methylation (a heavy item) would be about 6d. There are three material conditions for the successful manufacture of alcohol from the raw material mentioned, namely : a large area of suitable land within a comparatively short distance of the distillery ; a centrally situated distillery with an abundant water supply ; and rail or deep water carriage from the distillery. There are a number of river valleys on the coastal area of Queensland, where such conditions might exist.

METHOD FOR THE DETERMINATION OF REDUCING SUGARS BY FEHLING'S SOLUTION, ELIMINATING CERTAIN ERRORS INVOLVED IN THE PRESENT METHODS *F. A. Quisumbing and A. W. Thomas.*[2] *Journal of the American Chemical Society, 1921, 43, No. 7, 1503–1526.*

This is an important paper on the determination of reducing sugars, its purpose being to establish conditions for the use of Fehling's solution so as to eliminate the errors due to : variations in the boiling point owing to changes in atmospheric pressure[3] ; the reducing action of sucrose[4]; the auto-reduction of the copper reagent[5]; and the lack of an exact control of the temperature of reduction. As the result of the investigation, the authors arrive at the following conclusions: Variation of the b.p. due to the ordinary changes in the atmospheric pressure, and to the location of laboratories at different altitudes, may seriously affect the accuracy of the methods at present in use. Reduction due to sucrose present in the sample under examination may be considerable when current processes are applied. Auto-reduction of the Fehling's solution prepared according to the generally used formula occurs, that is to say, when Fehling's solution is heated under the conditions of the test without the addition of any reducing sugar a certain amount of cuprous oxide is precipitated (which may be as much as 5 mgrms., but is not constant), so that it becomes necessary when following the usual methods to run a "blank" determination. Then in regard to the temperature of the reduction, it was found that this has a marked influence, and the conclusion drawn was that this is a point that requires more careful attention than is generally given. The temperature obtained in a boiling water-bath, or even that by boiling directly over a flame, is stated to be indefinite; while the methods depending upon the direct boiling of the mixture are subject to the additional lack of accuracy due to the difficulty of fixing precisely the commencement of the boiling.

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[1] Government Analyst, and Chairman of the State Committee of the Commonwealth Institute of Science and Industry.

[2] Contribution from the Chemical Laboratories of Columbia University.

[3] *J. Amer. Chem. Soc.*, 1899, **21**, 369 ; *Zeitsch. Ver. deut. Zuckerind.*, 1911, **61**, 426 ; *Comptes rendus*, 1915, **161**, 617 ; *Ibid.*, 1916, **162**, 145.

[4] *Comptes rendus*, 1915, **161**, 617 ; 1916, **162**, 207 ; *Bull. Assoc. Chim. Sucr.*, 1913–14, **31**, 183 ; *J. Amer. Chem. Soc.*, 1906, **28**, 439.

[5] *J. Amer. Chem. Soc.*, 1907, **29**, 541.

A method of obviating these several sources of error has been elaborated. It depends upon effecting the reduction at 80°C., instead of at b.p., heating at this temperature being continued for 30 mins., instead of the shorter period specified in other processes. Under these conditions, it is stated that Fehling's solution gives no "blank"; while the presence of as much as 400 mgrms. of sucrose has no effect on the accuracy. A modified Fehling's solution is used, 41·2 grms. of pure cupric sulphate being dissolved in 500 c.c. of water for the blue, and 65 grms. of sodium hydroxide and 173 grms. of crystallized Rochelle salt (these three reagents being of the highest purity) in 500 c.c. for the white liquor. In carrying out the determination, 25 c.c. of the copper sulphate solution, and the same volume of the alkaline tartrate, are measured accurately into a 400 c c. beaker, the diam. of which is about 9 cm.; 50 c.c. of the sugar solution are added to make a total volume of 100 c.c.; the beaker is covered with a watch-glass, and placed in a water-bath maintained at a temperature of 80°C. After exactly 30 mins. heating, the cuprous oxide is filtered with the aid of suction through a mat of asbestos in a Gooch crucible, the precipitate washed in the usual manner, and its amount determined by a reliable method, preferably the Beans and Stillman electrolytic process[1] The corresponding weight of reducing sugars is found from the following equations, in which y represents the mgrms. of the sugar, and x the mgrms. of copper: Dextrose, $y = 0{\cdot}474x + 0{\cdot}000115x^2$; levulose, $y = 0{\cdot}526x + 0{\cdot}000078x^2$; invert sugar, $y = 0{\cdot}504x + 0{\cdot}0000870x^2$. In regard to the weights of the sample which should be taken for analysis, in the case of dextrose, levulose and invert sugar, the amount may be 50 to 150 mgrms., which weights will reduce about 100 to 350 mgrms. of copper. For mixtures of sucrose and invert sugar not more than 200 mgrms. of sucrose may be present, unless more than 160 mgrms. of reducing sugars are present, in which case as much as 400 mgrms. of sucrose will not affect the result. A series of determinations with dextrose showed the mean error of the proposed method to be only approximately ± 0·12 per cent., proving it to be highly accurate as compared with other methods in current use

UTILIZATION OF THE HEAT OF THE BOILER FLUE GASES FOR THE DRYING OF PULP IN THE BEET FACTORY. *H. Claassen.* *Deutsche Zuckerindustrie, 1921, 46, No. 48, 692.*

Kessler[2] recently wrote an article on the advantage of utilizing the flue gases for the desiccation of the pulp of the beet factory; but Dr. Claassen here points out that the writer named appears to have confused the heat in the waste gases from the boilers with the total heat loss of the boiler-house. If this latter amounts to 30 per cent. of the calorific value of the coal, the loss in the flue gases is 18–20 per cent., and the remaining 10–12 per cent. represents the heat lost by radiation. But of the 18–20 per cent. of the calories in the waste flue gases, only 60 per cent. can be utilized in a pulp dryer, i.e., a total of 10–12 per cent. only of the available heat of the fuel, and not 20 per cent , as Kessler had assumed. It is thus impossible to produce 22,500 kg. of dry pulp daily with the flue gases from a group of boilers of 600 sq. metres heating surface (as was stated), the amount of heat available sufficing only for the drying of 12,000 kg. at the most. A simple calculation is given in illustration. In working 1000 kg. of roots the amount of coal ordinarily used is 80–90 kilos. of 6000–6500 calories, i.e., about 540,000 calories. If this coal be burnt so that on the average the flue gases have a CO_2 content of 10 per cent., the proportion of flue gases amount to 18–19 kg. per 1 kg. of coal, that is, 1665 kg. of gases at 250°C. for 90 kg. of coal, the specific heat of the gases being 0·254. Then the gases would contain $1665 \times 0{\cdot}254 \times 250 = 105{,}750$ calories, or 19·5 per cent. of the calorific value of the coal. But as a fall of temperature of 150°C. only can be realized, the heat available is equivalent to $1665 \times 0{\cdot}254 \times 150 = 63{,}450$. In order to evaporate 1 kg. of water from the pressed slices, about 700 calories are required, including the heat lost by the dried slices, and that lost in the cooling of the dryer. Thus, with the heat at disposal from the working of 1000 kg. of roots, only 90 kg. of water can be evaporated. About 350 kg. of pressed pulp at 15 per cent. of dry matter (or 300 kg. at 17·5 per cent.) result from 1000 kg. of beets, for the drying of which it is necessary to evaporate 292 kg. of water (or 242 kg.); but as the flue gases can evaporate only 90 kg. of water, it is only possible to dry with these gases about 31 per cent. (or 37 per cent. when the pressed slices contain 17·5 per cent. of dry matter), and certainly not at least 50–60 per cent., as KESSLER had calculated.

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[1] *Dissertation,* Columbia University, 1920.

[2] *Deutsche Zuckerindustrie,* 1921, 46, 643.

INFLUENCE OF SAND IN WASHING BEET CARBONATATION PRESS SCUMS [AND THE IMPORTANCE OF CARE IN SAMPLING PRESS SCUMS.]

Vladimir Staněk. Zeitsch Zuckerind. Czecho-Slovakian Republik, 1921, 45 (iii) *105-109.*

Sand or grit is considered by MÜLLER[1] to have a very harmful influence on the washing of press scums. During the filling of the press, due to the shock of the pump, the sand is shaken to the bottom of the chamber, increasing the permeability of the cake in that part, so that when sweetening off the upper parts are insufficiently exhausted. However, experiments carried out by the author show these views to be mainly untrue. Eight sugar factories were requested to sample their press cake by taking a number of slices, 20 mm. wide, from the bottom, the sides, and the top. Analyses of these many portions of press cake showed a very striking variation of sugar content according to the sample, even when taken from parts of the cake close to one another, for example, the lower edge, where results carrying like 0·4, 1·0, 1·5, 3·3 and 4·0 per cent. of sugar were obtained. Therefore, it would seem that altogether erroneous results may be obtained if one single slice or piece of cake is relied upon as the sample for analysis. Quite a number of separate pieces should be taken, and mixed together. As MÜLLER had stated, the sand in all cases was highest in the bottom portion of the cake. On the other hand, instead of the sugar being lowest in the sandy portion of the cake, it was higher there on the average than at the sides and the top. It would seem that instead of the sandy part being more pervious than the rest, the contrary appears to be true. In fact, experiments on the rate of filtration through small pieces of cake in a special apparatus devised by the author showed that the higher the amount of sand, the lower the permeability, this result being ascribed to the grains of sand filling up these spaces in the cake which ordinarily would permit the passage of water throughout the mass.

CALCULATIONS USED IN THE ANALYSIS OF MIXTURES OF SUGARS.

J. F. Liverseedge. Analyst, 1921, 46, 446-450.

Equations are given for correcting the specific rotatory power of a sugar or mixture of sugars for temperature and concentration. Examples are also stated of the method of calculating the proportions of the various commercial sugars in solutions from the observed specific rotatory power before and after inversion, the value of K (i.e., the reduction, expressed as dextrose or levulose) before and after fermentation, and the total organic solids. A table of constants and factors for the more important sugars is also given.

J. P. O.

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[1] *Zeitsch. Zuckerind. Czecho-Slovakian Republik*, 1921, 45, (ii) 243.

Review of Recent Patents.[1]

UNITED KINGDOM.

Polarizers of Saccharimeters. *Adam Hilger, Ltd.; Wm. E. Williams; and Chas. F. Smith,* of 75A, Camden Road, London, N.W. 1. *166,842 (29,333).* October 18th, 1920.

In the two chief types of 2-field polarizers now in common use, viz., the Cornu-Jellett and the Lippich, while the former has the disadvantage of having a pronounced separating line between the two fields, the latter has the inherent defect that owing to a difference in intrinsic brightness of the two fields due to the interposition of a second nicol covering part of the main field, any slight double refraction occurring between the polarizer and analyser will cause an appreciable error in the value of a rotation. In the case of a saccharimeter employing white light filtered through a potassium bichromate solution, the rotation value found for a sugar solution depends on the spectral luminosity curve of the observer. According to the present invention, a half shadow polarizer is provided from which both the above defects are absent, and which has the additional advantage that the half shadow angle can be made variable without the necessity of rotating the analyser to make a match.

FIG 1

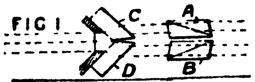
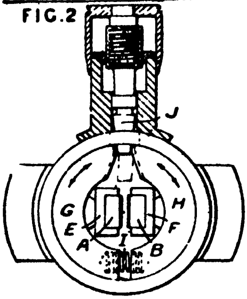


FIG.2



Referring to the Fig. 1 of the illustration, two polarizing-prisms *A B* and two equally inclined plates *C D* are so arranged that the beams emerging from the prisms can be brought together with a fine separating line, the planes of polarization of the prisms which contain a small angle between them, being approximately parallel with or perpendicular to the refraction plane of the light passing through the plates *C D*. When it is desired that the polarizer shall have a variable half-shadow angle without the necessity of moving the analyser, the two prisms are separately mounted. Fig. 2 shows them mounted in carriers *E F* carried by semi-circular rings *G H* movable in an external framework. The lower ends of the rings are urged apart by a spring *I* and the upper ends bear against the coned spindle *J*. By screwing down the spindle *J*, the prisms are rotated through small angles in opposite directions.

Beet Harvesting Machines. *Maschinenfabrik Walter and Kuffer,* Schweinfurt-on-Main, Germany. *170,837 (27,077).* October 30th, 1921.

A machine for digging or lifting beet and like root crops comprises a top-cutting device adapted to be adjusted automatically to cut off root tops of uniform thickness, and means for throwing the cut tops laterally, for lifting the roots from the ground, and for discharging them laterally or rearwardly.

Production of Alcohol for Motor Fuel. *W. R. Walkey and A. F. Bargate,* of Victoria Street, Westminster, London, S.W. 1. *171,479 (23,849).* August 16th, 1921.

Seaweed is macerated in water and the mixture is heated in an autoclave at a pressure of seven or eight atmospheres. The resulting liquid separates on cooling into two layers, the lower one of which contains all the salts and is separated from the upper layer containing glucose and other fermentable matter. The solid residue is subjected to a second digestion with dilute mineral acid. The aqueous and acid extracts are mixed, neutralized with chalk, fermented with yeast, and distilled to yield alcohol. The residue remaining after the treatment with acid may be subjected to dry distillation to yield wood-spirit, acetone, and a creosote-like substance, which may be used for denaturing the alcohol.

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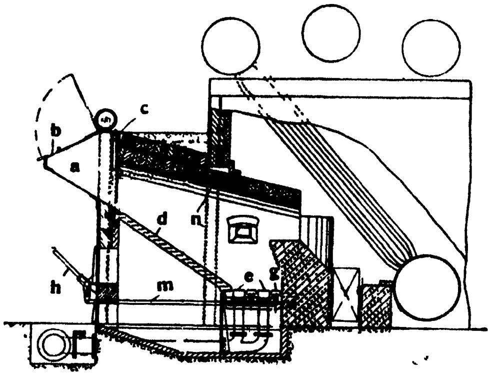
[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2fr. 00 each).

Boiler Furnace burning Bagasse, etc. *The Stirling Boiler Co., Ltd., and H. J. Sutherland Mackay,* of Westminster, London, S.W. 1. *150,617 (2918).* Januaary 30th, 1920. (Three figures; four claims.)



As shown, the improved furnace is provided near its upper end with a charging hopper *a* consisting of a wrought-iron or steel chute with a top cover *b* connected by means of a wire rope or the like with a guillotine *c* located in the furnace end of the hopper in such manner that the guillotine closes at the moment the cover of the hopper is opened to charge the same with fuel and no air can be admitted to the furnace. Beyond the guillotine door within the furnace is disposed a step grate *d* on which the fuel moves by gravity, being dried and partly consumed in its downward path. At the lower end of the step grate *d* are disposed blast bars *e* formed with a plurality of openings on their upper surface and connected by air pipes, supplied with air under pressure by a fan (not shown) located outside the furnace. Intermediate with these blast bars are disposed a series of rocking bars *g* adapted to rock on pivots and operable by means of links *m* extending outside the furnace by a handle *h*. Above the step grate *d* is located a sloping arch *n* which projects into the main combustion chamber of the boiler, and for this reason is capable of radiating sufficient heat to drive off superfluous moisture from the fuel passing over the step grate. The lower portion of the furnace consisting of the rocking bars and forced draught bars serves to deal with the charcoal formed in the furnace due to the formation of fine ash around the fuel, which fine ash prevents the necessary oxygen for combustion coming into contact with the bagasse or the like to be burned. By means of the rocking bars, the mixture of carbon and ash is agitated so as to free the surface of the carbon; and by means of the forced draught bars, the necessary amount of oxygen is provided to ensure perfect combustion.

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Heat Exchange Apparatus in Evaporators, Condensers, etc. *Ingersoll-Rand Co.,* of New York, U.S.A. (Assignees of *P. A. Bancel,* of Nutley, New Jersey, U.S.A). *164,727 (13,814).* May 17th, 1921; convention date, June 5th, 1920; *not yet accepted;* abridged as open to inspection under Section 91 of the Act.

To increase the efficiency of a heat exchanger in which steam is condensed, the flow of vapour with its admixed air is retarded at points between the cold surfaces.

Dyes for Alcohol Fuels. *L. Knight,* of Wimbledon Park, London. *170,075 (19,552).* July 8th, 1920.

Petrol, alcohol, or other liquid fuel is coloured by dyes or colours that are soluble in the fuel but insoluble in water, that will not impair combustion, and that will not corrode or otherwise damage the engine. Aniline dyes are preferred, a suitable proportion being 1 to 500,000 of petrol. Dyes specified are: Non-sulphonated azo dyes, Soudan 1, Soudan 2, Soudan 3, Soudan Red, Soudan Brown, Oil Red S, Ceres Red 6, Ceres Yellow, Ceres Orange, 500 S Moti Gelb, Moti Violet, and Spirit Yellow R.

Coating Confectionery. *R. F. MacFarlane,* of Imperial Biscuit Works, Fulham, London. *164,564 (9635).* April 6th, 1920.

Packing Caramels, etc. *G. W. Morrison and Clarke, Nickolls & Ccombs, Ltd*, of Victoria Park, London. *164,832* (*7497*). March 12th, 1920.

Relates to the packing of unwrapped caramels, etc., and consists in providing a strip of paper, having an upturned edge and projecting tongues, on to which the caramels are fed, the strips being cut into lengths and the loaded strips fed into a box.

Reducing Cocoa, etc. *Jos. Baker & Sons, Ltd., and R. Head, and W. E. Prescott*, of Harlesden. *164,860* (*7950*). March 17th, 1920.

In a process for reducing cocoa, cornflour, arrowroot, etc., the material is fed to a conical disintegrating-mill whence it is carried by a current of air into a sifting-device, the material passing through the sieve being carried off for use while the tailings are ground and returned to the disintegrator.

Centrifugals. (1) *G. H. Elmore*, of Swarthmore, Pa., U.S A. *144,979* (*3644*), February 6th, 1920. (2) *C. A. Fesca & Sohn*, of Lichtenberg, Berlin. Germany. *145,397* (*979*). January 12th, 1920. (3) *H. P. Hoyle*, of Durham. *164,500* (*7265*). March 10th, 1920.

Grinding Chocolate, etc. *E. C. R. Marks* (communicated by the *National Equipment Co.*, of Springfield, Mass., U.S.A). *166,085* (*2194*). September 15th, 1919.

A reducing-disc for use in refining or reducing apparatus for cocoa, chocolate, etc., is described.

Moulding Confectionery. *L. d'Onofrio*, of New York. *166,531* (*18,836*) July 12th, 1921; convention date, July 17th. 1920; *not yet accepted*; abridged as open to inspection under Section 91 of the Act.

A machine is described for moulding and coating candies or the like with starch previous to coating them with sugar.

Fermentation of Starchy Materials for the Production of Acetone and Butyl Alcohol, etc. *Charles Weizmann and H. M. Spiers*, of Kensington, London, W. *164,366* (*9132*). June 3rd, 1918.

In order to diminish the production of acetone and butyl alcohol, and increase that of butyric and acetic acids, the fermentation described in specifications 4845 of 1915[1] and 164,023[2] may be effected in the presence of an excess of calcium carbonate; or an excess of sodium carbonate may be added, and carbon dioxide passed through the solution to form sodium bicarbonate; or again an excess of sterile ammonia and some ammonium chloride may be added.

Filter-Press. *E. F. Engelke*, of Tampico, Mexico, U.S.A. *163,105* (*4065*). February 10th, 1920.

Filter-presses, of the type in which the plates have apertures in their body which together form a supply conduit for the several plates, are divided into sections by means of partition plates, each of which has one or more radial channels, connected at their outer ends to the main supply, and delivering at their inner ends to the line of apertures.

Feeding Cocoa Nibs to Grinding Machines, etc. *E. C. R. Marks* (*National Equipment Co* , of Springfield, Mass., U.S.A.) *163,261* (*7125*). November 4th, 1919.

Means for delivering cocoa nibs or the like to a pair of hoppers comprises a measuring hopper positioned above and between the hoppers and adapted to be oscillated so as to supply measured charges alternately to the hoppers.

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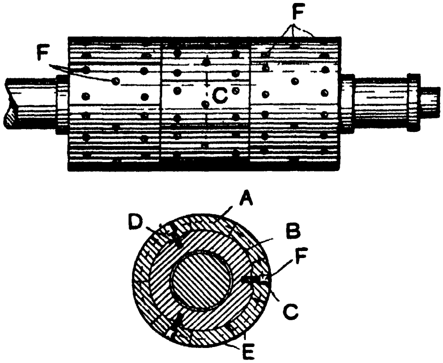
[1] *I.S.J*, 1919, 359. [2] *I.S.J.*, 1921, 179.

UNITED STATES.

CANE MILL ROLLER. *Manuel Garcia Fernandez*, of Buenos Aires, Argentina. *1,390,693*. September 13th, 1921.



The invention consists essentially in forming the circumference of the cylinder by juxtaposed plates fixed in a position normal to the shaft and held through splines and screw rings to the already worn-out jacket previously grooved or that which has been cast on purpose to a smaller diameter. As shown in the figures, circle *A* represents the limit of wearing out through use, that is to say, when the roller has become useless; circle *B* represents the part that has to be turned; and *C* designates the plates with holding ribs *D* forming part of the cover of plates *E*, each one of which is fixed to the roller by a plurality of screws *F*. When new rollers have to be made, they must be cast and turned until reaching diameter *B*. When it is a case of having to repair common cylinders which have been worn out, the rollers must be grooved until the same diameter *B* has been reached, which can be done by turning them without having to dismount the mill, and then fitting the lining formed by plates *E* and which will increase the diameter to the requisite point. Claim is made for:—A crushing roll comprising a central cylindrical portion having longitudinal grooves formed in its periphery, a plurality of juxtaposed circumferential plates approximately wedge-shaped in cross section and having longitudinal ribs engaging said grooves, and bolts passing through the plates and ribs into said central portion for securing the plates to the latter.

CANE PLANTERS. (1) *Norman K. Lyman*, of San Francisco, California. *1,383,833*. July 5th, 1921. (2) *Edward H. Hipple*. of Honolulu, T.H. *1,386,407*. August 2nd, 1921. (3) *George G. Powell*, of New York. *1,387,511*. August 16th, 1921.

(1) Claim 4 is as follows: In a sugar cane harvester, a vehicle, stalk topping means carried by the vehicle on one side thereof but close to the side of the vehicle, means for elevating and lowering the topping mechanism, a stalk severing device also carried by the vehicle but at a greater distance from the side thereof than the topping mechanism, means for elevating and lowering the severing means, and means carried by the vehicle adjacent the forward end thereof for bending the stalks over in the direction of the vehicle to have their tops removed by the topping mechanism after which they may be cut by the severing means, and stalk catching means carried directly in rear of the severing means.

(2) Claim 1 is as follows: In a device provided with a furrow opener and furrow closer and a feed depositor between the opener and closer, a means for lifting the said members in co-operative relation comprising an arcuate rack mounted to the furrow opener and a pinion co-meshing with the rack, a chain driving the pinion for lowering and lifting the opener, a member operable of the chain inter-connected with the furrow closer, a chute pivotally mounted in abutment to the furrow closer whereby upon the movement of the furrow closer the chute will also be moved.

(3) Claim 3 is as follows: In a machine of the character described the combination of a platform, a cutter housing hinged to the platform, a pair of rotating shafts journaled in the housing, flexible rubber steadying wheels and circular cutters fastened to each shaft one over the other, the cutters on one shaft in the same horizontal plane with the cutters on the other shaft, the steadying wheels on one shaft in the same horizontal plane with the steadying wheels on the other shaft and means to deliver cane stalks to said wheels and cutters.

Recovery of Potassium Salts from Distillery Spent Wash. *Milton C. Whitaker* (assignor to *U. S. Industrial Alcohol Co.*). *1,376, 662.* May 3rd. 1921.

Cane molasses, suitably diluted, is fermented in the presence of hydrofluosilicic acid in quantity insufficient to precipitate all the potassium salts in solution, but sufficient to inhibit undesirable fermentations, using preferably a yeast accustomed to the presence of this acid. After the completion of the fermentation, the alcohol is distilled off in the usual way, while the spent wash is treated with an additional quantity of hydrofluosilicic acid, this time sufficient to throw down all the potassium salts from solution. By heating the precipitate with sulphuric acid, the hydrofluosilicic acid is driven off and may be recovered,[1] while the potassium sulphate remaining may be purified by solution in water and re-crystallization.

Machine for making Sugar Loaves by Compression. *André Boivin*, of Paris. *1,379,847.* May 31st, 1921. (Eleven figures.)

Claim 4 is as follows: In a machine for manufacturing by compression sugar loaves or compressing any other material capable of being moulded, the combination of a cylindrical truncated mould, at least one hollow compressing piston of cylindrical truncated shape adapted to slide in the interior of the said mould and two solid compressing pistons adapted to slide respectively in this hollow piston and in this mould, operating means for moving the different pistons mentioned, these means being adapted to produce, at the time of the moulding, first the descent of the upper compressing piston and its entrance into the hollow cylindrical part of the hollow piston and then the carrying along of the hollow piston by the upper piston, and afterward the descent of the upper piston into the hollow piston which has become stationary, at the same time as the ascent of the lower piston and at the time of removal from the mould, the simultaneous descent of the upper piston of the hollow piston and of the lower piston, then the stoppage of the hollow piston, the two others continuing their movement, and finally the descent of the lower piston alone.

Manufacture of Decolorizing Carbon. *Milton B. Punnett and Raymond A. Whitaker* (assignors to *Eastman Kodak Co.*, of Rochester, New York). *1,383,755.* July 5th, 1921.

In an example stated, about 100 parts of comminuted vegetable matter, as hardwood sawdust, are added to 100 parts of an aqueous solution containing 75 per cent. of nitre cake. This mixture is allowed to stand for several hours, then heated in an open retort in contact with the atmosphere to a temperature between 300 and 500° C., until the mass has been completely charred, which ordinarily occurs in 30–60 mins. if the mass has been stirred at frequent intervals, the end-point of the reaction being the diminution of the evolution of sulphurous fumes. When it has sufficiently cooled, this charred mass is stirred into the least amount of water that will dissolve out the salt, the aqueous mass being heated to boiling, filtered, and the charred and purified product dried and ground to a fine powder. Lastly, it is heated in a closed retort to 800–1000°C., during about 20–30 mins., the resulting decolorizing carbon having "a most excellent and powerful action." Other vegetable products serving as raw material include straw, vegetable ivory nuts, cocoanut shells, paper, etc.; and the salts used are alkali metal sulphates, as sodium or potassium sulphate, or sodium or potassium acid sulphate.

Beet Seed Planter. *J. D. Samuels and H. E. Bates.* *1,396,784.* November 15th 1921.

Beet Thinner. *Walter R. Gwin.* *1,381,148.* July 11th, 1921.

Confectionery Manufacture. *Thos. Alva Ebaugh*, Kansas City, Mo., U.S.A. *1,397,757.* November 22nd, 1921.

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[1] Using, if desired, the process set forth in the inventor's previous patent, Serial 209,606, filed December 31st, 1917.

Sugar Crops of the World.

(Willett & Gray's Estimates of Crops to January 26th, 1922.)

	Harvesting Period.	1921-22. Tons.	1920-21. Tons.	1919-20. Tons.
United States—Louisiana	Oct.-Jan.	238,393	150,996	108,035
Texas	,, ,,	2,920	6,238	None
Porto Rico	Jan.-June	395,000	438,494	433,825
Hawaiian Islands	Nov.-July	480,000	508,392	496,183
West Indies—Virgin Islands	Jan.-June	5,000	4,500	12,400
Cuba	Dec.-June	3,500,000	3,936,040	3,730,077
British West Indies—Trinidad	Jan -June	52,000	54,933	58,416
Barbados	,, ,,	30,000	24,817	54,279
Jamaica	,, ,,	35,000	40,000	46,875
Antigua	Feb.-July	10,500	11,320	15,540
St. Kitts	Feb.-Aug.	8,000	8,063	10,036
Other British West Indies	Jan.-June	10,000	10,000	5,651
French West Indies—Martinique	Jan.-July	20,000	25,000	19,097
Guadeloupe	,, ,,	32,000	28,000	25,500
San Domingo	Jan.-June	250,000	185,546	175,736
Haiti	Dec.-June	3,000	5,625	4,125
Mexico	,, ,,	110,000	115,000	92,000
Central America—Guatemala	Jan.-June	19,000	17,500	15,100
Other Central America	,, ,,	18,000	20,000	20,000
South America—				
Demerara	Oct.-Dec. and May-June	90,000	96,168	85,356
Surinam	Oct. Jan.	10,000	12,000	7,169
Venezuela	Oct.-June	16,000	15,000	18,000
Ecuador	Oct.-Feb.	7,000	6,998	7,628
Peru	Jan.-Dec.	325,000	350,000	330,000
Argentina	May-Nov.	175,000	202,158	298,709
Brazil	Oct.-Feb.	250,000	300,000	177,155
Total in America		6,091,813	6,572,788	6,246,892
Asia—Brit. India (consumed locally)	Dec.-May	2,200,000	2,349,000	3,049,157
Java (1922-23—1,625,000)	May-Nov.	1,626,654	1,508,755	1,335,763
Formosa and Japan	Nov.-June	425,000	342,176	283,482
Philippine Islands, *exports*	,, ,,	276,000	255,843	209,336
Total in Asia		4,527,654	4,455,774	4,877,738
Australia (1922-23—300,000)	June-Nov.	289,000	175,000	162,298
Fiji Islands	,, ,,	65,000	73,000	88,000
Total in Australia and Polynesia		354,000	248,000	250,298
Africa—Egypt (consumed locally)	Jan.-June	100,000	79,706	86,712
Mauritius	Aug.-Jan.	200,000	259,872	235,490
Réunion	,, ,,	35,000	40,000	32,336
Natal	May-Oct.	150,000	140,000	142,851
Mozambique	,, ,,	40,000	45,000	38,746
Total in Africa		525,000	564,578	536,135
Europe—Spain	Dec.-June	5,000	6,886	6,048
Total cane sugar crops		11,503,467	11,848,026	11,917,111
Europe—Beet sugar crops		4,039,500	3,713,598	2,585,488
United States—Beet sugar crop	July-Jan.	900,000	969,419	652,957
Canada—Beet sugar crop	Oct.-Dec.	23,000	34,600	16,500
Total beet sugar crops		4,962,500	4,717,617	3,254,945
Grand total Cane and Beet Sugar	**Tons**	**16,465,967**	**16,565,643**	**15,172,056**
Estimated decrease in the world's production	**,,**	**99,676**	**....**	**....**

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1922. Tons.	1921. Tons.
Total Receipts January 1st to January 25th	202,103	69,890
Deliveries ,, ,, ,,	202,103	71,796
Meltings by Refiners ,, ,, ,,	170,000	64,973
Exports of Refined ,, ,, ,,	24,000	4,000
Importers' Stocks, January 25th	none	9,146
Total Stocks, January 25th	63,545	63,605
	1921.	1920.
Total Consumption for twelve months	4,107.328	4,084,672

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1918-1919, 1919-1920, AND 1920-1921.

(Tons of 2,240 lbs.)	1918-19. Tons.	1919 20. Tons	1920-21. Tons.
Exports	3,825,239	3,363,773	2,585,727
Stocks	—	192,471	889,781
	3,825,239	3,556,244	3,475,508
Invisible Supplies	—	53,833	330,532
Local Consumption	146,537	120,000	130,000
Total Production	3,971,776	3,730,077	3,936,040

Havana, December 29th, 1921.

J. GUMA.— L. MEJER.

Beet Crops of Europe.

(Willett & Gray's Estimates to January 26th, 1922.)

	Harvesting Period.	1921-22. Tons.	1920-21. Tons.	1919-20. Tons.
Germany	Sept.-Jan.	1,330,000	1,152,960	739,548
Czecho-Slovakia	Sept.-Jan.	650,000	705,919	493,781
Hungary and Austria	Sept.-Jan.	100,000	90,000	12,151
France	Sept.-Jan.	285,000	305,041	154,444
Belgium	Sept.-Jan.	280,000	242,589	146,918
Holland	Sept.-Jan.	335,000	316,402	238,692
Russia (Ukraine, Poland, etc.)	Sept.-Jan.	100,000	89,071	78,013
Poland	Sept.-Jan.	225,000	189,834	140,000
Sweden	Sept.-Jan.	227,000	164,194	145,072
Denmark	Sept.-Jan.	120,000	134,835	152,852
Italy	Sept.-Jan.	200,000	135,484	182,843
Spain	Sept.-Jan.	135,000	170,722	81,650
Switzerland	Sept.-Jan.	5,500	3,710	8,550
Bulgaria	Sept.-Jan.	22,000	7,837	10,974
Rumania	Sept.-Jan.	25,000	5,000	....
		4,039,500	3,713,598	2,585,488

Sugar Market Report.

Our last report was dated 7th January, 1922.

The past month was quite satisfactory as regards actual trade demand. Stocks having reached the point where replenishment became necessary to carrying on from day to day, offerings of Czecho-Slovakian, American, etc , sugars were freely taken at gradually advancing prices; but although some sales were made for later positions, the latter were, generally speaking, neglected. Tate's London Granulated is quoted at 46s. 3d. prompt, 46s. 6d. April/June; Czecho-Slovak Superior Granulated SCH, TTDA, etc., sold up to 18s. 6d. f.o b. near, and now nothing available in first hands before April, for which 19s. is quoted, April/June 19s. 3d. American Granulated c.i.f. U.K. ports is doing at 18s. 3d. February shipment.

Spot sugars have met with a good demand and good quality Granulated values 46s. duty-paid, whilst Mauritius Crystals are obtainable at 43s. 9d. to 44s. White Javas have been bought for re-export, said to be for India, and only small parcels remain at 44s. 7½d.

The Java Market has been active both for old and new crop positions and seems now to be subject to influences which place it apart from the other markets of the world; so much so, that one can hardly expect to see much of the new crop coming this way. Sugar in the East is comparatively cheap to the consumer, which means that India may still be reckoned upon as an important purchaser, perhaps even to a greater extent than last year; also China, Japan, etc., should prove a ready market for the Javas available. It is reasonable to assume that the tendency is, in all countries, to consume more sugar than last year, apart from the question of replenishment of invisible stocks. The old crop is practically disposed of and prices have been subject to big fluctuations, apparently due to the covering of short interests. Up to 19⅜ guilders f.o.b. was at one moment quoted for ready, and after a relapse to 17 guilders, to-day's quotation is 18¼ guilders, February/March 17½ guilders, with, however, hardly any buying interest A large business has been done in new crop positions and it is estimated that the Trust have sold totally upwards of 600,000 tons at improving prices. May delivery is quoted to-day at 13⅛ g , June 11¾ g. For India small quantities were done in this market last week at 18s. 3d. c. & f. Calcutta basis for June/July shipment, and to-day there are sellers of June/August at 18s. to perhaps a shade less. The stock of old crop sugar at the end of January is roughly estimated at 105,000 tons.

As regards Cuba, the course of events in the past few weeks shows that, whatever financial arrangements may have been come to about the old stocks of raws, these sugars are now being much more securely held, and are no longer at the call of buyers at throwaway prices. Considerable quantities have been disposed of by gradual day-to-day sales, up to 2¼c. c. & f. New York having been paid. U.K. refiners paid up to 12s. 10½d. c.i.f. for 96's and a cargo was sold to France at 12s. 3d. Some set-back has been experienced in the past ten days, and latest business reported is on the basis of 2$\frac{3}{32}$c. c. & f. New York, with sales to U.K. at 11s. 6d. and a cargo to France at 11s. 9d. c.i.f.

Latest cables from Cuba report 140 Centrals grinding, and receipts for the week 96,000 tons, against 164 Centrals and 94,575 tons at this time last year. The total stock at 4th February of 774,000 tons includes 610,000 tons of old crop sugar. Messrs. Willett & Gray have increased their estimate of the crop to 3,500,000 tons, whilst the Cuban Tax Commission publishes an estimate of 3,000,000 tons. This latter figure may be regarded as expressing a more or less assured minimum, any excess above which is an unknown quantity likely to be affected by the extent to which production may be stimulated by improvement in values.

In tables showing the world's output of sugar, recently published by the *Economic Review*, an interesting comparison is given of the percentages of beet and cane sugar in the totals of the 1913-14 and 1921-22 campaigns. From this it appears that in 1913-14 47·4 per cent. of the total output of the world was in the form of beet, and 52·6 per cent. cane, whilst the estimated total for 1921-22 comprises 31 per cent. beet and 69 per cent. cane.

H. H. Hancock & Co.

10 & 11, Mincing Lane,
London, E.C. 3,
February 8th, 1922.

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

Intensive Methods in the Field.

Apropos of our remarks in last month's issue upon more intensive methods in the field as the most pressing need of the day in the cane industry, we publish on another page a short article by A. H. ROSENFELD, formerly director of the Tucumán Experiment Station, upon the same subject. The raw material for the factory producing sugar crystals is drawn from the plantations and we think that this writer's ingenious references to the latter as the great out-of-door factory peculiarly apt and likely to interest our readers. For the rest, there are not wanting signs that the planters themselves are, in various other directions, inclining to take matters more into their own hands, so that the maximum of benefit may accrue from the investment of money in research in the cane fields.

The action of the British Guiana planters in submitting to a cess on each acre of planted cane, whereby funds may be raised for a thorough reorganization of their field methods under skilled scientific control will be fresh in everybody's mind, and the voluntary contribution by the various West Indian Colonies towards the establishment of a thoroughly up-to-date local Agricultural College—largely controlled by themselves—we regard as the thin edge of the wedge with the same object in view. It is more than certain, with the various "axes" at work cutting down our national expenditure in different directions, that less and less Government money will be available for supporting local agricultural industries in the Colonies, and the sugar industry, although passing through a natural reaction after its late phenomenal success, is well able to look after itself in most cases at the present time. India is, it is true, in a peculiar position, as will be readily conceded by those who have read the recently published Report of the Committee appointed by the Government at great expense to enquire into its sugar possibilities, for there is no body of planters there capable of bearing the burden. But the West Indies, having received untold benefits from the large sums of money devoted by the Government to the rehabilitation of their agricultural industries, have been placed in a thoroughly sound position. And it is only right, now that the need of national economy has become a matter of vital importance, that they should put their shoulder to the wheel and bear their due share in the burden of their agricultural departments which have been so liberally supported for them during the past quarter of a century. With a thorough appreciation of this fact, and the added inducement of being more self-contained so lucidly put before them by the Hawaiian Sugar Industry—of putting their house in order in their own way—we think that it will occur to all right minded planters in the West Indies, that the moment has at length arrived for them to cast off the swaddling clothes of Government protection—and interference—and to fashion their own garments so as to suit the altered conditions of the day.

The Economic "Axe" and West Indian Publications.

We have received with regret the announcement that the liberal subventions thus far granted by the Imperial Government towards scientific publications in the West Indies are about to be withdrawn. For many years past the *West Indian Bulletin* has from time to time issued articles of the highest scientific value and been placed freely before the public at the ridiculously small sum of a couple of shillings a year. Similarly, that most readable and useful fortnightly, the *Agricultural News*, filled with matter of great interest not only to planters in the West Indies but to all students of tropical agriculture throughout the world, has been broadcasted at less than the cost of the paper on which it was printed, leaving out of consideration the heavy charges for editorial, printing and other items. This latter periodical is now to be discontinued as from March 31st, 1922, and this is we believe to be followed by a serious curtailment in the *Bulletin* as well, which will perhaps be less easy to bear. In the circumstances, these changes are unavoidable and have been foreseen for some time past. The matter of agricultural literature of this valuable type is thus placed in the hands of the planters themselves, and we think that they will agree in a feeling of gratitude to the Imperial Government for having so long borne the cost of publication for them. In effect, the planters themselves are the members of the publishing firm and will be in a position, with the ample experience gained, to determine the true value of what has been done for them and to decide what form the dissemination of scientific and especially agricultural literature shall assume in the future. The annual reports of the agricultural departments will doubtless continue on much the usual lines, but these are hardly suitable and sufficient for a live body of planters who wish to keep themselves *au fait* with what is being accomplished both among themselves and in other parts of the world in agricultural progress.

Australian Affairs.

We would commend a careful perusal of the excellent article we publish by T. D. Chataway upon the side-lights and re-adjustment of the Australian Sugar Industry. This young industry has from its commencement received a great deal of attention from the Government, and has in consequence been alternately fostered and neglected. At the present moment it is expanding under the genial appreciation which, in 1919, saved it from practical extinction, and it would almost seem as if the Commonwealth is beginning to understand what a valuable asset it has in this Cinderella of its hitherto disregarded north-eastern coast line. A new agreement as to the price to be paid for home-grown sugar will shortly have to be considered and Mr. Chataway appears to be fairly confident that the way will be opened for the possibility of a stabilization of the industry for a further short term of years. We hope that this will be so. In the circumstances, it is difficult to see how the Queensland planters will be able to carve out their own destiny by taking over the Government Department created, under the able guidance of H. T. **Easterby**, for the caring of the sugar industry, though there are not wanting signs that they are making the best of the period of sunshine of the past year or two. We read in his Annual Report for last year (1921) that farmers in nearly every district are putting new areas under cane and more fertilizers have been purchased than ever before in the history of the industry: the millers have had their plants overhauled and have put in much needed improvements—in many cases increasing the capacity of their mills: the abundant crops of the present year will see a great deal of the indebtedness of the cane farmers wiped off and there is a fair chance of Queensland keeping Australia supplied with all the sugar it requires. We trust that this latter fact will bring in its train a fair price for sugar upon which the stability of the industry so much depends. But it is a great pity that so promising an industry cannot be granted a greater degree of self-control. We read, for instance concerning the new Sugar Experiment Station in the north where most of the expansion has taken place during recent years: "The piece of land used as a site was selected owing to its being Crown land. . . . The land is of poor quality both in available phosphoric acid and lime and, like most of the soils in the neighbourhood, contains a larger percentage of magnesia than lime. . . . The station due to its situation is a difficult one to deal with in some respects, and all the stores and material have to be transferred across the South Johnstone River. . . . One of the principal drawbacks at present is the getting away of cane varieties to farmers between Innisfail and Cairns, from which places numerous applications are received. . . ." It is hardly likely that the cane farmers, if they had had the location of the farm in their hands, would have fixed upon just this piece of land for growing the new varieties and conducting the field experiments on the results of which their own practice should be so largely built!

The Position of Kelham.

It has not been difficult to foresee that Kelham sugar factory was getting in a tight financial position; now we have recently had a statement in the House of Commons that leaves little doubt as to the gravity of the situation for the shareholders. To quote the Parliamentary report:—

Sir A. **Boscawen** (Minister of Agriculture) replying to Mr. **Royds** on February 22nd, said that the present financial position of the sugar beet factory at Kelham gave cause for anxiety. Owing to the high cost of erecting the factory the company had exhausted their capital by the end of last year, and the directors had applied to the Government for permission to borrow a further amount up to £200,000 in priority to the second mortgage held by the Government, and for a remission of the Excise Duty on home manufactured sugar The application of the company had been referred to a special Committee appointed by the Ministry in conjunction with the Treasury, under the chairmanship of Sir **William McLintock**. The Committee had recommended that permission should not be given to the company to raise further money to rank before the existing second mortgage and in regard to the Excise Duty they had pointed out that its remission would amount to a subsidy on beet growing at the rate of £24 an acre [? ton]. The Government had decided to act on the Report of the Committee, and the directors of the Company were considering the whole position, but owing to the high costs of production in this country at present they had suspended entering into any contracts with farmers for the growing of beet this season. The Government held £250,000 in shares in the company, which was half the issued capital, and had also advanced a loan of £125,000 to the company on a second mortgage, subject to a prior charge of £40,000 for cash advanced by the company's bankers. The Government had also guaranteed a dividend of 5 per cent. per annum on the 250,000 shares subscribed by the public for the 10 years ending 31st March, 1930. But this guarantee ceased if the company went into liquidation or ceased to manufacture sugar.

It should be understood that this fresh £200,000 which the Kelham directors wish to borrow is additional to that sum of £75,000 which in April 1921 they were authorized to raise as a first mortgage in order to qualify for the £125,000 second mortgage advanced by the Government.[1] Actually, it means that, all told, the starting of this experimental factory is costing some £900,000 in capital expenditure, and that merely to obtain a seasonal output of approximately 10,000 tons of sugar. To put it tersely, it cannot be done; unless indeed the Government come to the aid of the venture by suspending the Excise for some years. This would on the figures cited in the House of Commons save some £240,000 per annum. The Government have themselves sunk in the venture to date £375,000, so they stand to lose this sum either way, since if they refuse all alleviation of the Excise it seems probable that the company will be forced into liquidation. If they grant it, then the Treasury loses the revenue from the Excise. The decision must rest on whether the Government chose to direct their losses into a channel which will give this form of agriculture a further chance to justify itself in the end, or will prefer to cut their losses now and have done with the venture. All those who are interested in the experiment must hope that the former alternative may be pursued for a time at any rate, since it seems hopeless for any private company to continue, burdened with over-capitalization and faced with a heavy Excise and an usually low price for their output. Either way, the answer of Sir A. BOSCAWEN seems to suggest that, failing a prompt decision on the part of the Government, there may be no 1922 campaign, owing to difficulties in fixing on a remunerative price for the beets. The company aver that they cannot possibly pay £19 18s. 10d. per ton Excise duty on sugar which will probably average in price the equivalent of £15 per ton c.i.f., at any port in the United Kingdom, and at the same time pay to the farmers a price for growing the beet that would be acceptable to them.

The Claim of the British Sugar Beet Growers' Society.

Meantime it may be as well to set forth the reasons recently advanced by the British Sugar Beet Growers' Society for praying that the Government will remit the Excise duty. Their committee recently issued a statement in which having regard to (*a*) the very great benefits destined to accrue to agricultural production in the United Kingdom from the introduction on an extended scale of sugar beet cultivation; (*b*) the urgent need for, as far as possible, limiting this country's commitments to purchase indispensable commodities from foreign countries; and (*c*) the exceptional disabilities under which a new industry must almost inevitably suffer during the period of its establishment (this being especially the case at a time of general industrial dislocation, resulting in a very marked disparity between costs of production and prevailing market prices for commodities), it is urged that: (1) Representations shall at once be made to His Majesty's Government advocating the remission of the Excise duty upon sugar produced from beet grown in this country, until the industry is firmly established; (2) the industry be considered to be firmly established when a production is reached of 50,000 tons of sugar per annum, as laid down by the deputation to the Colonial Office introduced by the Rt. Hon. W. M. HUGHES, on the 21st of June, 1916.

As we write this, we gather that a deputation to the Prime Minister is being arranged, if possible, to urge these points on him. Since Cantley would also benefit by any remission of the Excise, it may not be out of place to suggest that the two factories would do well to combine in making a joint representation; and what is more, we think that if the two could come to some arrangement to pool their managements and run the two factories as one working concern (thus combining all the farming, manufacturing and technical experience that has been secured up to now) a considerable saving in overhead expenses might result. Both factories are individually too small to work profitably as a separate entity; but combined they might achieve some measure of success. It would be a national calamity if both factories were to cease operating at so practical a stage in the industry of sugar manufacture in England.

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[1] See *I.S.J.*, 1921, 245.

In view of the interest at present being taken in the Kelham factory, we are fortunate in being able to present on another page a detailed technical description of its plant and working arrangements, which description so far as we are aware is the first complete one that has yet been published.

The United Kingdom Per Capita Consumption.

Last month we stated in these pages that the consumption of sugar in the United Kingdom during 1921 according to the Board of Trade statistics amounted to 1,440,363 tons. But strictly speaking, since these figures include the molasses which is almost entirely used for non-human consumption (though a small proportion goes into the manufacture of edible treacle or golden syrup) this total is really too high. In order therefore to compare the *per capita* consumption of sugar in the United Kingdom more nearly with the figures given for the United States, one must deduct the molasses figures from the total, and accordingly the latter is reduced to 1,381,833 tons raw and refined. On this basis we figure that the *per capita* consumption of this country for the last few years has been as follows; we add the U.S.A. figures for comparison.

UNITED KINGDOM Year	Lbs.	UNITED STATES. Year.	Lbs.
1921	65·63	1921	84·47
1920	52·53	1920	86·56
1919	72·70	1919	85·43
1918	44.70	1918	73·36
1917	52·16	1917	78 58
1916	66·18	1916	79·34

As for pre-war consumption, LICHT gave the United Kingdom figure for "1911-12" as 91·68 lbs.[1]; but on the above basis and taking the 1911 census of the population, the 1911 consumption works out at no more than 82·72, a considerably lower figure than that of LICHT. We may add that the population for the above tabulated six years has been taken at 47,157,749 which is the 1921 census for Great Britain and the 1911 one for Ireland (these being the latest official figures published). That for 1911 was 45,370,530.

American Refiners and Cuban Sugar.

At the present moment there are indications in plenty that a group of the United States refiners are endeavouring to form a big combine or at all events come to a close understanding to secure a large share of the Cuban sugar supply and thereby capture a much bigger proportion of the refining industry of the world than they have hitherto possessed. During the war they started exporting refined sugar (refined in bond) to Europe, being aided in that policy by the inability of European refineries to supply the usual quota of world's refined. But having had a taste of the possibilities of such a trade, we shall not be surprised if they make a big attempt to keep and, what is more, extend it, at the expense no doubt of the British refining industry.

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[1] See *I.S.J.*, 1912, 263

The toll scheme by which 250,000 tons of Cuban raws have been bought at a low rate and are being refined for export to Europe is one indication; but it is facilitated by the present abnormal state of the unsold crop in Cuba. As regards the future, the attempt is undoubtedly being made to get control of the biggest and best raw sugar factories in Cuba and take their raw output for refining purposes on terms that will enable the refiners to compete favourably with any country. The fact that so many of the Cuban factories are mortgaged to the banks in return for financial assistance makes it an easier problem for the refining interests to come to terms via the banks for securing desirable sugar estates and centrals. If any such combine were to succeed it would be a very big and self-contained organization that would have an influence by no means agreeable to the individual sugar factory owner in Cuba, since the latter would be bound to be more or less subject to the will of the combine as regards the price he gets for his sugar.

Of late there have been a considerable number of visits to Cuba on the part of American bankers studying the sugar situation; while they have undoubtedly good reason to take every step they can to minimize their losses due to the depreciation of the Cuban securities deposited with them in return for loans, yet it is not difficult to see that if the refiners make them a good business proposition it will be to their interest to hand over to the refiners such sugar properties as are unable to meet their banking creditors in a satisfactory manner.

How far the American refining interests will succeed in securing control of the Cuban raw sugar industry it is impossible to say at this juncture; but that they are out to secure a commanding control of the best factories is not difficult of belief.

Since the British refining interests are directly threatened by any plans that will lead to increased exports to Great Britain of American refined, they will need to take steps to assure themselves of an independent supply of Cuban raws, just so long at any rate as they are indebted to Cuba for an appreciable supply of their raw material. In any event Cuba is going to continue to be a large sugar supplier; if she cannot find a market in Europe for her raws she will have to deliver them to the United States, mostly on the latter's terms. Both the British refiners and the independent Cuban producers are therefore both interested in maintaining direct relations untrammeled by the operations of the American refining interests.

Last fall there was an official deputation from Cuba to this country seeking for improved and more extensive trading relations. They were well received and had excellent opportunities for placing their case before the country. But we suggest that if British trade with Cuba is to develop, Cuba might be prepared to admit British machinery at more favourable rates than rule at present. The current tariff gives the States an advantage of 20 per cent. on imports of machinery as compared with other countries. If a like or at all events a substantially large proportion were conceded to British machinery manufacturers, there might be much better trading relations, for the more we export to Cuba, the more of her agricultural products we are likely to take in return. Cuba has good reason to thank the United States for past help; but she knows well enough that private trade is always self-interested and never magnanimous, and that there was a day when her sugar producers had to accept just what prices were offered by the only source that then bought the sugar—the United States refiners. She will not want to revert again to a disadvantageous position from which the war fortunately liberated her.

"Bank" Assisted Centrals in the Philippines.

An interesting account is given in the *Sugar Central and Planters' News* by the General Manager of the Philippine National Bank of the methods adopted for assisting financially six new sugar centrals that were built in the first instance with money loaned by the bank. At the beginning of 1921 the latter had advanced more than thirty million pesos[1] to aid in the construction of these centrals which were built by companies incorporated by sugar planters, but in which the planters themselves had put very little indeed of their own cash. All they had given the bank was a mortgage on their lands. By the date in question, however, the centrals were not completed while their cash credit advanced by the banks was getting exhausted. Not unnaturally they had no money with which to pay interest on their borrowings or to complete the plants; and with the break in the price of sugar the problem presented some discouraging features for the bank, as well as for the planters. Since, however, it was clear that the industry was at heart a sound investment if properly conducted, the bank organized a "Philippine Sugar Centrals Agency" to complete the plants and then gradually transfer the capital holding from the bank to the planters. The agency made a contract with the planters whereby it undertook to take over and market all the sugar produced by these centrals. Under this contract 45 per cent. of the sugar milled is to be allotted to the centrals; the proceeds from the sale of this will be used in covering expenses, paying interest on money borrowed, and then the balance remaining is to be applied either to enlarging the plants or redeeming the principal borrowed. We take it that in return for such redemption a corresponding amount of stock in the centrals will be transferred to the planters, so that in the end the latter will themselves own and operate the centrals in their several districts. The contract between the bank and the centrals runs for five years, and it is fully expected that before it expires the bank will be able to retire from the sugar business with safety.

The Agency is also interesting itself in extending the area under cane; and it proposes to co-operate with the planters to operate a field service. Every problem will be taken up for solution. The first will be the selection of cane cuttings, which must be of the right varieties and free from disease. Another problem is that of drainage and irrigation; and finally, the task of soil analysis with a view to determining the right distribution of fertilizers will be undertaken.

The 1920-21 crop was sold at low prices, but in spite of that, the 1921-22 crop promises the largest yield in the history of the islands. It too will probably be sold at a low figure but even then there will be a profit.

The above account is a good illustration of what can be done by a reasonable and cautious co-operation between the banks and the planters, and is in many ways a contrast to the speculative fever that pervaded like operations in the Cuban industry. The planters in the Philippines are progressive Filipinos who are willing to make present sacrifices for future betterment, and indications are that they will ultimately end by becoming prosperous sugar central proprietors.

Use of Tractors by Sugar Companies in Formosa.

According to a report of the Acting British Consul-General in Formosa, there are 44 tractors of U.S.A. manufacture now in use in that island. Competition with the United States product would seem, however, to be possible, as it is stated in the local press that a Swiss firm is sending a representative to Formosa with two

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[1] Say £3,000,000

Swiss tractors, the qualities of which are to be demonstrated before the Agricultural Experimental Station and the Sugar Section of the Government-General.

When tractors were first used in Formosa the drivers and engineers employed found the work very trying owing to the heat. For this reason and owing to the engineers' lack of experience, both of tractors and of agriculture, accidents were frequent and full benefits were not derived from the machines. Most sugar companies, however, adopted the new system and a considerable economy in wages and cattle feed has been effected.

Since then, the engineers employed have gradually acquired an understanding of the machines and of agriculture, and the tractors have been utilized to better purpose. Their economic value in the plantations, however, is largely dependent on the cost of petrol, labour and cattle feed. It has been established that they are not directly economical when fuel is expensive and labour cheap.

Figures showing the cost of ploughing by tractor and ox plough are given in the table below. The tests were carried out in July last at the Government Sugar Experimental Station. In both cases conditions were favourable for ploughing by tractors and no allowance was made for depreciation or the cost of repairs. The tractors ploughed to a depth of 8·5 to 9 5 ins. and the ox plough to a depth of 4·25 ins.

	(1) TRACTOR	(2) TRACTOR.	OX PLOUGH.
Cost per *Ko* (2·42 acres)..	Yen 10·544	Yen 2 121	Yen 9 600
Area ploughed per diem..	3 *ko*	2 *ko*	0·25 *ko*

Though the sugar industry is at present much depressed and a recovery is hardly to be looked for in the immediate future, Formosa should not be lost sight of as a market for agricultural motor tractors.

Attention may conveniently be drawn to an advertisement on page xxxvii announcing a new partnership of sugar consultants and technologists which is not without interest to the sugar industry at large. Mr. ROBERT MITCHELL, M I.Mech E., till last summer Managing Director of the Sugar Machinery Mfg. Co., Ltd , and Mr E. WUTHRICH, a distinguished Java sugar technologist, are combining to act as advisers and consultants on sugar factory machinery, sugar manufacture and cane cultivation ; they aim at a close co-operation between the sugar engineer and the sugar technologist in order to work on scientific lines and with scientific methods throughout. The engineer cannot do the work, they claim, nor keep the outlook of the technologist, while the latter needs the co-operation of the engineer, if the machinery is to respond fitly to the demands of the scientific staff. Mr. MITCHELL has had a wide experience in design and erection of sugar-making plants down to the complete factory. Mr. WUTHRICH has had a unique training and experience in sugar manufacture and cane cultivation in Java, while he also held there the position of Lecturer in the Sugar School at Soerabaya, and was Chemical Adviser to a large modern factory for several years. More recently he was engaged as adviser to several factories in South Africa. We understand it is the intention of these gentlemen to make a speciality of giving advice on White Sugar Processes, both sulpho-defecation and carbonatation, to such factories as desire to consider the problem of turning out with profit direct consumption sugars instead of the customary raws. As Mr. WUTHRICH (who is a Dutch Subject) has introduced with great success the double carbonatation process into the Mount Edgecombe factory, Natal, and Mr. MITCHELL has been concerned in supplying the plant for white sugar factories in Java, South Africa, and elsewhere, the new partnership would appear to be one of very considerable utility to the sugar industry. At the same time their activities are by no means being confined to white sugar manufacturing processes, but will take in every type of sugar production that modern practice recommends. We wish every success to the Consulting Department of Messrs. MITCHELL & WUTHRICH.

Till further notice the Board of Trade statistics of Imports and Exports and Consumption in the United Kingdom will appear quarterly, and not monthly as hitherto.

Fifty Years Ago.

From the "Sugar Cane," March, 1872.

In this issue a paper was published by E. **Feltz** on "Sucrates, and their Application to the Extraction of Sugar from Molasses." It dealt with the baryta process, according to which the solution of molasses was mixed with barium sulphide (using 1½ equivalents to 1 of sugar), sodium hydroxide (1 equivalent) added, and the saccharate thus formed filtered off and decomposed with sulphurous acid. This method of working had been put into operation in 1849 by **Dubrunfaut**, its inventor, at the factory of MM. **Tilloy** & **Bernard**, at Courrières, France, where it had been in use until a short time before the paper under consideration was written. Latterly, however, a modification of the process had been applied, this being very similar to the *modus operandi* protected by **Leplay**,[1] a collaborator of **Dubrunfaut**. Instead of using the sulphide, a liquor of caustic baryta at 30° Bé. was used, and the saccharate formed was decomposed with carbon dioxide, so that the method followed the same general lines as the Steffen lime process of the present day. According, however, to the figures stated the yield was very low, only about 32 per cent. of the sugar originally present in the molasses being recovered, so that evidently there were details either of proportions or temperatures which had been insufficiently considered at that time. Moreover, it was stated, the loss of baryta during its recovery was so high as to affect the economical results of the process.

The official paper on the analysis of sugars and molasses drawn up by the Association des Chimistes de Sucrerie de France, mentioned in our last issue,[2] was here continued. Certain analysts, it was explained, neglected to use the polariscope, and proceeded by assuming that the organic matter (which otherwise would be calculated by difference) was nearly equal to $\frac{4}{5}$ of the ash per cent., the water, ash, and organic matter thus found being added together, and the sum deducted from 100 to give the sucrose. This method was shown to give erroneous results when generally applied to raw sugars, for the reason that the amount of organic matter in any sugar varied according to the method of working. In those days it was common practice in raw sugar manufacture to put the syrups through char, which would retain a certain amount of organic matter, the salts being taken up to a less extent. On the other hand, filtration of the syrup was often imperfect, so that the ratio of organic matter to ash stated could by no means be assumed to be a constant value. Another point in the same paper was the calculation of the value of a raw sugar from its total ash content, that is all the mineral matter present, including the lime salts. Some refiners at that time knew better than to do this, and when buying raw sugars would select those which with the same total ash content contained the most lime.

An article was published on the state of sugar refining in Greenock. This branch of industry had been brisk on the Clyde during the previous year, the total raw sugar melted having been nearly 220,000 tons; and 10 sugar-houses operated. Regarding the capacity of some of these, **Alex. Scott** & **Son** had extended its output so that "the immense quantity of 1000 tons per week will be turned out by this firm"; the Glebe Sugar Refining Co., melted 700 tons; and the others amounts from 200 to 600 tons.

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[1] English Patent, 656 of 1859.

[2] *I.S.J.*, 1922, 88.

The Sugar Situation in the United States.[1]

The world sugar market has followed a very uncertain course during the last two years. During the years 1918 and 1919 the sugar prices and distribution of the world were under joint international control, and Western Hemisphere sugars were administered through the Sugar Equalization Board. The previous administration decided not to continue the operations of this Board beyond distribution of the 1919 crop, and immediately thereafter large speculative operations began with most disastrous results, whereas during the period of great stress of the war sugar was maintained at prices that dealt fairly with both producer and consumer. The control was obviously dissolved too early in view of the enormous disturbance to both production and consumption. The loss to the American consumer amounted to several hundred millions of dollars and was inevitably followed by a crash which has done infinite injury to the sugar producers themselves.

Disturbance of sugar market in 1920 and 1921.—At the close of the war sugar production was something like 2,000,000 tons below pre-war figures. Consumption had also dropped, and there was no way of knowing how soon consumption would increase and pass production. The principal change as a result of the war was the great reduction in beet sugar production in Europe, especially Germany, Austria, and Russia, and the enormous increase in cane sugar production in Cuba. As a result of the situation, there was much uncertainty as to supply and demand, and prices soared to an almost unheard-of height in 1920, when the wholsale price of granulated sugar in New York reached 26·50 cents per lb. in the months of May and June. It was soon discovered, however, that there was no real shortage of sugar in the world, and we had first a rapidly declining market and then a long, steady decline, reaching its lowest point at the end of December, 1921, when Cuban raw was quoted c. and f. New York at 1·75 cents per lb. and granulated as low as 4·80 cents.

Effort to stabilize price of Cuban raw sugar.—The most depressing market condition toward the end of 1921 was the large stock of unsold raw sugar in Cuba. This was produced at a high price, and in order to minimize the loss every attempt was made to sustain the price of Cuban raw. One of the most important steps was the appointment, in February, 1921, of the Cuban Sugar Commission, which took over practically the whole 1921 crop in order to stabilize the market. Doubtless this had some stabilizing effect on the market, but the fact that Cuban raw was frequently underbid resulted in the importation into the United States of sugar from other sources, such as Java, which normally does not reach this market in large quantities.

Causes of depression in last quarter of 1921.—At the end of 1921 there was estimated to be in Cuba 1,200,000 tons of old sugar, as against a normal carry-over of less than 100,000 tons. It was known that this sugar had been financed largely by American bankers; and, with prospects of the Sugar Commission going out on the 1st January, there was much speculation as to what would happen to the sugar market in case it was decided to liquidate this sugar and throw it on the market. Moreover, the Cuban mills began grinding the new crop in December, with enough cane in sight to produce 3,750,000 tons if all the cane crop is worked out. This situation produced a great depression on the sugar market during the last three months of 1921.

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[1] An article by the Chief of the Foodstuffs Division of the U.S A. Dept. of Commerce, appearing in *Commerce Reports*.

Prospects for absorption of surplus in 1922.—However, a careful survey of the world sugar situation indicates that if Cuba does not produce above 3,000,000 tons this year there is fair prospect that the present surplus may be absorbed by the end of 1922, with a world carry-over that will be not far from normal. The following figures are a comparison between the pre-war carry-over, production, and consumption, and those of 1921 and 1922 :—

COMPARATIVE WORLD SUPPLIES AND CONSUMPTION.

Periods.	Carry-over first of year. Tons.	Estimated production. Tons.	Estimated consumption. Tons.	Final carry-over, end of year. Tons.
Pre-war	750,000	17,500,000	17,500,000	750,000
1921	1,216,000	16,509,000	16,024,000	1,700,000
1922*	1,700,000	†15,887,000	16,500,000	‡1,000,000

The foregoing table is based on the best figures available at present, assuming that Cuba will produce only 3,000,000 tons this year. Any increased production on the part of Cuba or other producing areas, of course, will increase the carry-over for next year.

Shortage in "invisible" stocks at end of 1921.—At the end of December a careful enquiry among the trade was made by the Department of Commerce on "invisible" stocks or supplies usually held by warehouses and wholesalers. During 1918, when exact estimates of invisible stocks were made, they were found to vary from 200,009 to 900,000 tons, with a normal of about 600,000 tons. It is not possible to secure exact figures on invisible stocks at present; but all estimates were very low, apparently 300,000 to 400,000 tons below normal. This is a situation naturally growing out of a steadily declining market. Experience has shown that when markets decline the stocks in the hands of the wholesale, jobbing, and retail trade become low owing to the expectation that prices will fall further, and the natural tendency is to buy on a hand-to-mouth basis. With a rising market, on the other hand, such stocks become large owing to the attempt to anticipate the market. A rise in the market at present would undoubtedly result in a quick absorption of perhaps a half million tons in the stocks of the country. Reports from England show that the invisible stock is very low in that country also, being estimated by different authorities at 100,000 to 200,000 tons below normal. Presumably the same condition exists in other countries.

Reasons for expecting improvement in sugar market in 1922.—There is no way of estimating accurately just how much consumption should increase as a result of low prices. We know, however, that consumption does adjust itself, within certain limits, according to price. The very high prices of 1920 undoubtedly had a tendency to reduce consumption, as people soon discovered ways of economizing on high-priced commodities. Conversely, the relatively low price of sugar, which is now reaching the public through lower retail prices, will result in an increased consumption, which will be felt before the end of 1922. If we take this into consideration, together with the fact that the probable carry-over will be reduced to normal by the end of 1922, there is sound reason to expect that sugar prices should stabilize and gradually register some improvement.

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* Estimated.

† Assuming estimated decrease of 1,000,000 tons in cane sugar, as reported by Willett & Gray.

‡ The apparent carry-over of 1,000,000 tons may properly be reduced by the estimated deficiency of 400,000 tons in invisible stocks, which would leave a carry-over at the end of 1922 of only 600,000 tons.

There is now no artificial control on the sugar market for practically the first time since the early years of the war, and the law of supply and demand will henceforth determine the price of sugar. There was actual public concern over the prospect of a crash in the Cuban sugar market lest it might result in a very small Cuban production this year, because of difficulty in finding money for the new crop, which must be largely financed in advance. The fact that there is prospect of a stable market has enabled bankers who hold money against the old Cuban sugar crop to carry it safely and to advance sufficient money on the new crop to guarantee practically all the Cuban sugar that can be produced at a reasonable price.

Summary of sugar situation.—The following conclusions as to the sugar situation were issued by the Department on the 9th instant:—

1. There is an abnormal "visible" world surplus of sugar, amounting to about 1,200,000 tons, all congested in the Western Hemisphere.

2. The "invisible" stocks—that is, sugar in the hands of distributing trades, wholesale and retail—is far below normal. The amount of subnormality is variously estimated at from 300,000 to 400,000 tons, and is no doubt due to apprehension of further fall in prices.

3. The probable world production for 1922 is estimated to be less by from 400,000 to 800,000 tons than the production of 1921.

4. The consumption for 1922 is likely to be larger than in 1921, and with general economic recovery should exceed production and thus absorb some or all of the surplus.

5. The present price of $1·87 for c. and f. raw sugar is the lowest level for 20 years, and is below the cost of production about 90 per cent. of both domestic and Cuban sugar.

6. This low price of sugar has resulted not only from the fear of the large visible surplus but also from the apprehension of financial difficulties in the sugar market that have been current during the past few months. It has been assumed that in the falling market there might be forced realization of the loans made against existing surplus stocks of sugar; that there would be difficulty in financing the new Cuban crop; that the financial difficulties of the Cuban Government itself might not be readily solved; that there might be bankruptcy amongst sugar producers; that the dissolution of the Cuban Sugar Commission on January 1st might result in considerable liquidation of sugar.

7. The Cuban Sugar Commission was dissolved on January 1st, and it is now demonstrated that no appreciable forced liquidation is likely to take place. The banks generally have been well covered down to the low prices of sugar, and there is no likelihood of forced realization. There appears to be sufficient money for financing the new crop wherever it can be produced on a reasonable basis of cost, and the Cuban Government seems to be in a fair way to solve its financial difficulties.

8. The market is now entirely uninfluenced by any artificial control, and the present low-price level manifestly cannot long continue without restricting the production of sugar below the world's demands and again creating high prices.

The Customs revenue of the United Kingdom for the 12 months ending March 31st, 1921, included a sum of £29,370,000 derived from import duties on sugar. Home grown sugar is not separately recorded in the Excise statistics, being lumped with glucose and saccharin, so it is not possible to state the revenue from that particular source.

The Australian Sugar Industry.

Sidelights on Re-adjustment.

By T. D. CHATAWAY, ex-Senator for Queensland.

It has been my privilege to place before the readers of the *International Sugar Journal*, in two successive years, my views as to how the cane sugar industry may develop under what are considered White Australia conditions. Practically a year has elapsed since I last wrote, and a further "progress" report may be not without value.

It will be recalled that the sugar output was commandeered by the Commonwealth during the war, and consumers and manufacturers were supplied at a rate far below the cost of importing sugar. In 1920 in answer to the demand of the sugar producers that they should be entitled to export (while exporting was good) or charge higher rates for home consumption, the Commonwealth Government made a three years' agreement, namely to the end of the season 1922, to purchase the whole of the sugar output for £30 6s. 8d. per ton of 94 per cent. sugar at the nearest wharfside to point of production. This was distinctly a good bargain for all concerned. It stabilized the industry and made it profitable; it also enabled the Government to make a good profit out of the Australian sugar at a time when it was losing heavily over the sugar it imported. What the Government lost over its buying dear sugar and supplying it at a rate far below cost is not definitely known, but to-day it is making a profit of £7 per ton out of the Queensland raw sugar, and hopes, according to the Auditor-General, to wipe out its deficit by the end of next June. As the Australian production this year will reach 300,000 tons it is clear that the Government is making over £2,000,000 profit as an offset to the losses incurred by keeping sugar down in price during the boom period.

Obviously this cannot go on, but to arrive at an estimation of the basic position in the near future we must first of all assume that the profit of £7 a ton will soon be a thing of the past. Then the sugar producer will still, through the raw sugar mills, earn £30 6s. 8d. per ton for 94 per cent. sugar, and if that figure pays the mills and the growers now, it will equally pay them when the Government ceases to draw its £7 a ton profit; and consequently the cost of sugar to the consumer falls by a like amount. That the margin at present gives both growers and mills substantial profit is openly confessed, and additional proof is afforded by the fact that several of the central mills have completely liquidated their liabilities to the Queensland Government, and so lifted the mortgages upon the lands pledged for the original loans.

PROMOTING SECONDARY INDUSTRIES.

Further, in order to show what the effect has been upon secondary industries, I should like to interpolate the following figures officially supplied to the *Australian Sugar Journal* for December, 1921 :—

IMPORTS.

	1913 (calendar year).		1920–21 (ending June).	
	lbs.	£.	lbs.	£
Preserved milk	120,786	2,913	96,660	4,928
Biscuits	485,488	17,238	39,205	3,545
Confectionery	8,701,965	448,619	440,566	75,127
Jams and jellies	453,951	12,213	379,401	14,543

The figures speak for themselves. The local manufacturers have not been at any disadvantage by the competition of imports. When we come to the export figures (and these are the real test) we find the following :—

	EXPORTS 1913		1920-21.	
	lbs.	£	lbs.	£.
Preserved milk	951,654	39,808	35,115,421	2,053,369
Biscuits	6,256,327	81,798	7,550,678	270,304
Confectionery	441,917	20,000	2,129,547	165,386
Jams and Jellies	1,858,231	29,402	16,535,335	550,403

If one looks back to the years of the war and immediately following the armistice, the great volume of exports in the above commodities is more notable, but I have taken the latest period of "slump," and even this shows that an export trade worth in 1913 £170,000 has increased to £3,000,000. No better testimony could be sought as to the value of the sugar industry to Australian manufacturers, despite their outcry that the industry has been bolstered up at their expense, and that the production of sugar is merely maintained to gratify the greed of over-paid white working men. The Government has now agreed to make a most generous rebate to exporters of manufactures into which sugar largely enters, namely £20 per ton, giving them sugar for £26 a ton. The rebate is given on exports on the assumption that the proportion of sugar used is as follows:—Jam, one half; canned fruits, 5–36ths; candied peel, 5–36ths; cordials, 2½ lbs. per liquid gallon; condensed milk, 7–20ths, or 2–5ths, according to whether analysis is required or not. Seeing that the manufacturers have expressed themselves as well satisfied with the above rebates it may be assumed that £26 per ton of mill whites is the lowest price that the sugar producers would have to face, if the agreement were cancelled. If that assumption is a fair one, the raw sugar mills have to anticipate at the worst a fall of £5 per ton from the present price paid for raws.

REDUCING COSTS.

If we eliminate the excess price now being charged the consumers, in order that the Government may recoup its losses made during the war and early post-war period, we reach the question as to whether the Commonwealth can accede to the request for a further agreement, under which it will continue to pay £30 6s. 8d. per ton for raw sugar. Even with £6 per ton import duty it would seem that it could not do so in full. It admits as much by its treatment of the exporting manufacturers. Were the latter charged £26 plus the import duty of £6, they would then only be paying for white sugar on the spot £32 a ton, so that the Commonwealth cannot pay £30 for raw sugar practically at the mill door, with many costs to follow. Clearly the next stage, as mentioned by me a year ago, is so to adjust the cost and methods of working as to reduce the initial costs of production, and thereby making it possible to sell at something below the present price of raws. The first and obvious economy is in the cost of harvesting. Cane was readily cut a few years ago by white men, who earned £1 a day, but the price has been forced up until now men work few hours and leisurely to earn £2 a day and upwards. A trade paper in the United States remarked not long ago that a cotton-picking machine would be invented the moment the cotton planters really wanted it. The same may be said of a cane-harvesting machine. To-day the farmers do not seriously want it. The very suggestion of a machine is condemned in advance. It will not cut the bottoms low enough, or it will not top; it will be too heavy, or it will cost too much. In a recent trial a machine, upon which the inventor had spent his fortune and a lifetime, was allowed to show its capabilities in a field of arrowed cane, 25 miles from the nearest town and engineer shops, and in a situation where only a limited number of farmers were likely to see it at work. The Australian Sugar Producers' Association had given £500 towards the expenses, but there was none of that keen interest which will be felt so soon as the grower is driven by sheer necessity to really want a mechanical cutter. In many cases the growers are afraid that they will offend the powerful labour unions if they dare to encourage anything which may serve to multiply the work done by the cutting gangs. Patentees of such machines as have been partially tested usually place the cost of cutting a ton of cane at from 1s. to 1s. 6d. The present cost in Queensland is from 7s. 6d. to 8s. There is therefore a saving of, say, 6s. 6d. a ton of cane to be made, which would mean 58s. 6d. per ton of raw sugar. This with the greater regularity of the work, and the cutting of the cane during the best of the season, might well be reckoned as worth £3 per ton of sugar. The mills would then be able to accept £27 for their sugar, knowing that the suppliers can be paid 6s. 6d. a ton less for their cane, and no one will be a penny the worse.

THE SIZE OF MILLS.

There is a satisfactory recognition of the fact that the most economical way to treat cane is by concentrating it in large mills. It is perhaps unfortunate that the two largest and newest mills are under Government control, and though they do not by any means pay the growers the highest possible price for their cane, they do succeed in making the cost of a ton of sugar excessively high. The tendency is to enlarge existing mills, or to move those where the cane supply is insufficient for profitable work to localities where they will receive enough cane to keep them fully occupied, day and night, for the longest profitable part of the year. Of the two mills mentioned above, Babinda, costing £371,000, in the 1920 season made about 16,000 tons of sugar, and though the expenses ran to £28 11s. 11d. per ton (including the manufacture of some whites) there was a profit over the whole of the operations of £2 1s. 10d. per ton. South Johnstone, making rather less sugar made a profit of £1 9s. 11d. Nothing but the large crop dealt with rendered these results possible. At the Proserpine, where the Government is also in control, the output of 4000 tons yielded a profit of 4s. 2d. per ton, being insufficient to meet its obligations to the Treasury. The two big mills are already unable to cope with the increasing supplies offering, and have actually been obliged to refuse new contracts. In the early days of the co-operative central mills it was customary to publish the fullest figures of the cost of manufacture at each stage, but this practice has slowly fallen in desuetude. It is, however, hardly necessary to argue that there is much room for economy in a few large mills, rather than in many small ones. To facilitate the working of mills to their fullest capacity steps are being taken in some cases to open up fresh cane areas, but to readjust supplies so that all mills shall have ample, instead of some an over-supply and others too little. This is only a matter of organization, and the growers themselves are beginning to realize that if every mill in a district is to be kept fully occupied the cane available must be pooled, as it were, and sent to the mills where it will do the most good.

THE WASTE OF MOLASSES.

On a previous occasion I referred to the criminal waste of molasses, the chief by-product of the cane sugar factory. It is difficult to say whether in this respect we are making much progress, but at least something is being done. The following table, which is official except where stated to the contrary, shows the general molasses position of Australia during the last few years.

In the past with the exception of a few tons imported by Western Australia from Java, the whole of the imported molasses came from Fiji, where the Colonial Sugar Refining Company has estates. In 1908 the writer was informed by the Company that even were a duty imposed upon molasses it would not pay to bring it down from North Queensland to Sydney. The only use to which Australian molasses were put was the manufacture of potable alcohol, horse-feed, fertilizers and fuel. The import trade from Fiji is declining, and during the past year tank steamers have been carrying molasses from Cairns, in North Queensland, to Brisbane, where the Commonwealth Government during the war erected an acetone factory, and where it is now making industrial alcohol. It is understood that at present this factory is only paying 30s. per ton for molasses, and seeing that the production of molasses this year in Queensland is known to be about 75,000 tons, there is clearly a substantial sum to be earned if all the molasses were thus used, equal to about 6s. per ton of sugar, or 8d. per ton of cane. But there is much more than this. According to the Commonwealth Institute of Science and Industry[1] a ton of molasses will yield 65 gallons of industrial alcohol. In 1917 the value of this in Melbourne was 2s. 6d. per gallon, and unhappily prices have not fallen since, but rather risen. Thus a ton of molasses yields slightly more than £8 worth of alcohol, which means a gain of £2 on every ton of raw sugar made, or about 4s. 4d. per ton of cane. But it is neither the 8d. nor the 4s. 4d. per ton of cane which would mean so much to the grower, though the additional earning will help to bring down the cost of the raw sugar. The production of cheap industrial alcohol on the spot will enable the growers to largely dispense with horses, harness, stablemen, shoeing smiths, and many other sources of expenditure. The mechanical difficulties of alcohol as a fuel have been overcome, and so soon as dire necessity compels him the cultivator will adopt this very necessary reform. When the last agreement was made by the Commonwealth Government, the Prime Minister, Mr. W. M. HUGHES, made it a sine qua non that the growers should extend their cultivation and produce sufficient sugar to supply all Australia. This year (1921) they have done more and it is expected that 1922 will see a further addition to the 45,000 tons to be carried over at the end of next June. If there is to be a fresh agreement, covering the period 1923-25, we may expect that Mr. HUGHES will press for other reforms, possibly along such lines as the above. If these are adopted it is not difficult to visualize the raw sugar mills and the growers being able to carry on at lower prices for both sugar and cane, and still continue to earn handsome profits.

Year Calendar.	Production. Tons	Year ended 30th June.	Imports. Tons.	Exports Tons.	Quantity available Tons.	Used in distilleries per cent. on quantity available.
1916	47,340	1917	10,831	11	58,160	44·28
1917	78,220	1918	10,475	125	88,570	35·45
1918	55,830	1919	6,442	37	62,235	40·20
1919	46,764	1920	8,935	48	55,651	39·92
1920	44,750*	1921	9,319	156	53,913*	46·01*

REFINING COSTS.

I have already indicated how there is in sight the means to economize in production or increase income sufficiently to cover most of the reduction which may be anticipated in the price to be paid for raw sugar, but under the heading of "Refiners' Costs" further economies are quite possible. Under the current agreement between the Commonwealth Government and the refiners there is a table of costs which, if not excessive at the time, certainly seem so now. It is only fair, however, to say that the rates compare favourably with those stated for

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* Estimated by me.

[1] "Power Alcohol," Bulletin No. 20.

South Africa,[1] where railage of raw sugar and refining costs are placed at £7 per ton. A recent agreement by the American Cane Growers Association with the Chalmette refinery provides that the former shall pay the refiners 90 cents per 100 lbs. for refining and sale, or £4 4s. per long ton. Seeing that the growers have to deliver the raw sugar at the refinery, the charge works out, including the Australian raw sugar freight rate, at 1s. 6d. more than provided in the Commonwealth agreement. According to a statement made in Parliament by the Prime Minister the Australian costs between £30 6s. 8d. per ton for 94 per cent. raws, and the refined products are as follows:—

	£	s.	d.
Freight	2	0	0
Selling commission	0	7	0
Managing costs	1	2	6
Refining charges	1	3	0
Bags	1	0	0
Coal	0	10	0
Total	£6	2	6

To the least experienced it is clear that a very considerable saving could be made, if the necessity became insistent. The item of freight is extortionate, more being charged to bring the raw sugar from North Queensland to, say. Sydney, than is asked for bringing coal from the United Kingdom to Australia. The line of railway from Brisbane northwards along the coast, mentioned by me in the article published in this Journal, in March, 1921 (p. 142), is now operating as far north as Mackay, and it was only the other day that the chairman of one of the central mills in the latter district was reported as having stated that he calculated that there was a saving of 24s. 6d. per ton to be made by using the railway instead of shipping to the New Farm refinery at Brisbane. This possibly may err on the side of optimism, but it is certain that if the American system of long-distance freights were adopted such a saving would be effected that the shipping charges would have to be materially reduced. Other items in the above sum agreed upon with the refiners during the days immediately following the Armistice are naturally subject to re-adjustment. With the reduced value of sugar the commission paid for selling must fall, and, though for the moment the volume of consumption appears to be stationary, with its increase, which may be safely anticipated, the ratio of managing costs must also become less per ton.

TO DEFEAT THE REFINERS.

The table of refining costs, however, cannot be fully understood by those who are advocating the manufacture of whites at the raw sugar mills, as a means to eliminate the refining profits. In the past the refiners, when making contracts to purchase raws, have always provided a qualification by which a mill might use a certain proportion of its sugar for local sale or to try its luck on the open market with mill whites. Under the Commonwealth arrangement a similar concession is made to the extent of 1 per cent. of the output of each mill. Thus a mill making 7000 tons may make 70 tons of whites, but its sale of these is restricted to the farmers and workers in the neighbourhood, who must buy in quantities of not less that 70 lbs., and the Government collects £4 13s. 4d. per ton as a sort of local excise. This last charge was a surprise to the mill managers, who found they had signed an agreement which enabled the Government to make this charge by regulation, though not expressly mentioned in the contract.

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[1] *South African Sugar Journal*, 1921, p. 985.

Probably full advantage has been taken of the concession, but obviously it can prove little. It is stated that the Babinda mill, already mentioned, spent £3 per ton in changing its raw sugars to whites, but that Mulgrave Central, one of the best managed of the co-operative mills, was able to make an equally good sample at a cost of 10s. per ton. In any new agreement if the making and marketing of mill whites is to be tried out effectively, there must be no internal tax, and the area over which the makers can sell must be unrestricted. Naturally, the moment they try to sell outside their immediate districts they are faced with questions of transport, commission charges, and commercial risks. It is with these last that they must of necessity be most concerned. In the old days a mill in the Mackay district sold £5000 worth of sugar to an Adelaide firm, but before the bills in payment fell due the firm went insolvent, and the mill sustained an almost complete loss, which at that time was nearly fatal to it. It is difficult to see that the risks of making and selling mill whites will be justified by the problematical profits to be made. It has also been suggested that it would be a reform if the mills in one district railed their massecuite in steel containers to a central factory, which, working all the year round, would make white sugar, industrial alcohol, and all the other by-products. The underlying principle of this idea is not so much that it would defeat the refiners as that it would make the refining process operate on the spot, instead of near to the chief markets for the finished article—a reversion to a practice long abandoned in practically all cognate industries.

WHITE AUSTRALIA.

It will be noted that in the foregoing I have indicated certain lines of economy, but with the exception of the adoption of harvesting machinery, so as to reduce the cost per ton, I have not advocated anything which might be construed into seeking a general reduction in wages rates. I am not prepared to argue that, in the present circumstances, white labour in the Australian tropics is demanding and receiving an extravagant wage. Recently a tentative agreement was reached between the fruit-growers of the southern States and the labour Unions by which wages rates from December, 1921, to the end of April, 1922, were fixed for all operations in connexion with the harvesting of fruit. The lowest wage to be paid to male or female employees over 18 years of age was 80s. per week; males under 18, 70s.; females, 60s.; females under 15, 50s.; and others in proportion. Yet it is employers paying these rates who complain that the white man in the tropics is extravagantly subsidized by all who use sugar when he is paid less than 80s. a week. The chief trouble with white labour in the tropics is that it is undisciplined. If men would work steadily, and not for unnecessarily long hours, the rates of wages could be even increased, but disputes are of far too frequent occurrence—disputes arising as often as not amongst the men themselves. The other day an "organizer" called a stop-work meeting of all hands at one factory to discuss whether or not a levy should be made to establish a daily newspaper in the southern cities. Incidentally the men refused, but the matter had nothing to do with their employment, and the work suffered. If wage-earners would understand that every interruption of this sort means an added reason why wages should be reduced, they would probably cease to cause frivolous but expensive loss of time. There is seldom actual trouble in the ordinary field work. Most of the farmers are their own employes, as may be understood from the fact that there are in Queensland 4000 plantations, or farms, and the average area under cultivation is only 41 acres. Last year I mentioned the steady increase of population in the agricultural tropics of Queensland. The census taken last April confirms this, showing that the population of the Herbert division, which practically includes the whole of the sugar-growing areas of Queensland above the twentieth parallel of south latitude, has increased since 1911 by 19·6 per cent., namely, from 76,635 persons to 91,564. The census was not taken at a time when the districts were flooded with migratory labour, because in April the harvesting season is as a rule two months away. The only fly in the ointment is the general belief that white aliens are largely responsible for the increase—a conclusion which may be justified by the low percentage of the adults in the Herbert who have complied with the statutory obligation to enrol themselves, if entitled, for electoral purposes. In the face of the facts the labour question ceases to be one of anxiety, much less despair, though it may often prove one of expense and annoyance, seeing that the workers themselves have not yet learnt to appreciate their obligations, and their leaders have been afraid to assert any authority. This, however, is but a passing phase, and should not be allowed to obscure the main problem facing the Australian sugar industry. That problem of re-adjustment is, as I have endeavoured to show, by no means insoluble.

Big Yields and More Technical Supervision.

By ARTHUR H. ROSENFELD.

In the annual report of Mr. HAMILTON P. AGEE, Director of the Hawaiian Sugar Planters' Experiment Station presented to the last meeting of the Sugar Planters' Association in Honolulu,[1] he advocates an appreciable reduction in the cane area of those progressive islands and the securing of better yields by ascertaining, under technical supervision, the maximum potential yield, fertilizer, irrigation and drainage requirements etc. of each acre.

With this end in view the association has been for several years conducting an extremely interesting demonstration—one pregnant with possibilities of super-intensive sugar production, the most outstanding result of which is that for the past two years the plant cane and long ratoons in this test have averaged 12 tons of sugar per acre, some areas yielding more than 15 tons of sugar per acre (17 acres of plant cane yielded an average of 15·8 tons of sugar per acre).

"Are these yields accidental?" inquires AGEE. "If not, is there anything impracticable about the methods by which they were secured? Can such yields be obtained upon a larger scale?"

The answer to the first two questions can be nothing but a rotund negative from the agricultural technician familiar with sugar cane plantation methods, labour and technical supervision—or the lack of the latter—whereas from the same source an affirmative reply to the third query is equally inevitable when a careful investigation is made of the methods employed in obtaining these results. They were, succinctly :—

1. Extraordinarily close technical supervision of each acre tested.
2. Intensive fertilization, through ascertaining the *practical limit* and then applying it.
3. Very careful irrigation, but no excessive quantities of water.
4. A careful decision from each acre of the proper time for cessation of irrigation and ripening the cane before harvesting.

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[1] See *I.S.J.*, 1922., 66.

The last three of these desiderata on every sugar plantation are manifestly in large measure contingent upon the first, and this is precisely what is in so large a degree lacking in the very industry which, perhaps, employs the lowest class of labour and, hence, that needing the most superior technical direction of any other world-wide industry with which it can properly be compared.

The average sugar factory owner will spend tens of thousands of pounds to increase his yield of sugar on cane by one-tenth of 1 per cent., to obtain 1 per cent. superior juice extraction at his mills or reduce the sugar remaining in his press cake by an infinitesimal margin, and will increase his technical supervision at the industrial end *ad infinitum* with any of these important objects in view. In no industry, probably, even in the most backward countries, is there such vigorous, complete and expensive technical control of every stage of manufacture as in that of sugar-making, yet what do we find at the raw material end—the real basis of *any* industry?

Outside of some of the more progressive countries, such as Hawaii and Java, real technical supervision of the canefields is practically an unknown quantity. In many places the manager, usually a factory man, is a species of autocrat in his own domain, and too often his ideas of the agricultural necessities of his realm run along the lines of those held by the average farmer of the past generation as regards "book-larnin'" in agricultural operations. The writer still recalls with a smile a recent argument with such a general manager, who told him with the blandest assurance that he was "opposed to anything mechanical in the field." Yet this man had donated to himself the proud title of *mechanical* engineer, and was constantly recommending the most detailed and expensive control of every small operation in the factory!

Now this, unfortunately, is a typical case and expresses a point of view all too common towards the agricultural operations of a sugar estate—an outlook on agriculture that has come to us down through the ages. The agricultural side of the industry has in general fallen very far short of keeping pace with the newer and more spectacular industrial side. Not that the writer is advocating any less control in the sugar-house—far, far from it! It is not that he loves the factory less, but the field more. What the industry must wake up to, however, above all in these critical times, is that the greatest and most important factory is that whose roof is the broad dome above us, whose combustion engineer is no less important a technician than Old Sol himself, whose defecation is accomplished through capillary pores, and whose steam is distributed amongst the fibro-vascular bundles of his plant, where evaporation is accomplished by stomata and methyl blue replaced by chlorophyll—yes, where the chemicals are already stored in the great laboratory of soil and air by the Greatest Chemist, only awaiting our knowledge of their location and how to draw the stoppers of the greatest carboys and flasks known to science. Because our greatest factory has cost us nothing, is it logical to operate it with less efficiency than yon huge pile of brick and steel whose tall stacks serve as guide posts to the humble workers in Nature's broad plant below? Wouldn't it be more sensible, more appreciative—yes, wouldn't it show far more business acumen?—to operate our agricultural plant with the same technical care as our industrial one—to learn to utilize our nature-bestowed chemicals, steam pipes, and suction pumps with just as much care and efficiency as we do with those which we have purchased at so high a price? If so, *let us have, then, more technical men in our canefields*!

Value of Farmyard Manure in Crop Production.[1]

By EDWARD J. RUSSELL, D.Sc., F.R.S.,
Director of the Rothamsted Experimental Station.

FARMYARD MANURES v. ARTIFICIALS.

So satisfactory have artificial fertilizers proved that agricultural chemists have sometimes thought they represented all that there is in agricultural chemistry. Until very recently if a man proposed to speak on scientific agriculture it was expected of him that he would praise artificial fertilizers and disparage farmyard manure. Good farmers have always, however, insisted that farmyard manure has advantages over artificial fertilizers. Experience at Rothamsted confirms this.

Fortunately the continued repetition of Lawes and Gilbert's experiments year after year on the same ground has allowed of the accumulation of data from which evidence as to other effects can be adduced. Wheat has been grown for 78 years with farmyard manure and with various artificial manures. A statistical examination by Mr. R. A. FISHER in our laboratories of all the data accumulated since 1852 shows that farmyard manure gives rather more regular yields than artificials: the fluctuations from season to season are not quite so marked, and although the farmyard manure never gives "record" yields, it also never does very badly. Further, the plot fertilized with farmyard manure shows no signs of deterioration after 80 years of continuous cropping with wheat, while all plots manured with artificial fertilizers, even the best, show clear signs of deterioration now.

Farmyard manure further appears to have a greater effect than artificials in increasing the growth of clover. Unfortunately the number of experiments on this is not very great, but the results are consistent, and the good effect is shown not only in the clover but in the succeeding wheat crop:—

	After farmyard manure in 1915	After artificial in 1915
Clover, 1917, cwt. per acre	62·1	46·2
Wheat, bushels of grain per acre	45·1	37·1
Wheat, cwt. of straw per acre	45·3	36·8

Again, farmyard manure produces effects on root crops, and particularly on mangolds, which artificials will not give. On the Barnfield at Rothamsted there are 26 plots receiving artificials only, and 10 receiving farmyard manure. Up to the end of July the dunged plots stand out in sharp contrast with the others, showing a vigour of growth produced by none of the artificials.

All these facts (and other which might be adduced) go to show that the first generalization in regard to farmyard manure, viz., that it owes its fertilizing value to its nitrogen, potassium and phosphate, does not express the whole truth. It has a large measure of truth and much pragmatic justification; it has given us our artificial fertilizer industry and in addition a great deal of our present agricultural chemistry; but there is something in farmyard manure which is not covered by this generalization. Attempts are therefore being made to find out what causes these further properties: we are now seeking a second approximation.

EFFECT OF ACCESSORY SUBSTANCES.

It is of course possible that there are chemical constituents in farmyard manure which are essential or highly desirable to plants, but not present in our artificial fertilizers. The old idea that nitrate, potash and phosphates suffice for crop growth may be wrong. This aspect of the subject has been much investigated in France. G. **BERTRAND** began it by classifying apart the "engrais complémentaires," which in present-day terminology would be called accessory substances. Manganese, fluorides, copper, have all been considered effective by the French workers. Recent work by **MAZÉ** in Paris and Dr. **BRENCHLEY** at Rothamsted suggest that small quantities of boric acid may cause distinct increases in crops fully fertilized with artificial manures. We cannot as yet recommend farmers to adopt this kind of manuring with special substances, because it is very easy to overstep the beneficial limits, and then much damage is done to the crop; the effect seems to be rather in the nature of a stimulant than a food, and the plant suffers from excess just as surely as a man would do. However, it may prove possible to keep these effects within reasonable bounds and to ensure the same degree of control as we now have in the case of artificial fertilizers.

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[1] Extracted from a lecture entitled "Modern Applications of Chemistry to Crop Production," delivered before the Institute of Chemistry of Great Britain and Ireland.

OTHER EFFECTS.

There is evidence that the cellulose in straw (which as litter constitutes about three quarters of the dry matter of farmyard manure) may be responsible for the special farmyard manure effects. It seems possible that the cellulose or some of its decomposition products may exert a special effect on the micro-organisms living in the clover root causing an increase in the amount of nitrogen fixation, thus giving larger clover crops and further enriching the soil in nitrogenous organic matter.

It also seems possible that certain decomposition products of cellulose are responsible for the remarkable physical effects which farmyard manure is known to exercise on the soil, causing it to become puffed up so that the empty pore spaces increase in size. The air supply to the roots thus becomes better, the water supply is more evenly regulated, the work of the tillage implements is lightened, and a good tilth is more easily obtained. The plots at Rothamsted receiving farmyard manure contain always some 2 to 5 per cent. more moisture than those receiving no manure or artificials only, and this enables the mangolds to keep growing during a drought which effectually checks all plants not receiving farmyard manure.

Lastly, there is a clear relationship between the supplies of farmyard manure and the population of micro-organisms in the soil. The importance of this population to the growing crop is only now being realized. It is known, however, that the farmyard manure and the green manure we put into the soil are not really agents of fertility, but only raw materials out of which fertility is manufactured. The work is done by the myriads of living organisms in the soil, and their activity is increased by the presence of farmyard manure.

FOUR POSSIBLE EXPLANATIONS.

There are thus four possibilities to be investigated in regard to farmyard manure:—

1.—Some of its constituents other than the recognized nitrogen, potash, and phosphate may prove of value to the growing plant.

2.—The cellulose or some decomposition products may exert a special action on the nitrogen-fixing organisms in the roots of leguminous plants.

3.—The decomposition products of the cellulose may profoundly modify the colloidal character of the soil, thereby changing its physical properties.

4.—Farmyard manure influences the micro-organic population of the soil.

Work in all these directions is proceeding at Rothamsted and elsewhere. It is clear that the problem is much broader than was envisaged by the older chemists; in addition to the one factor of plant nutrients which they studied so thoroughly, there are now known to be these four others which we have still to work out.

A good beginning has been made in the study of soil micro-organisms, and already we understand something of them and their work. There are two main lines of decomposition of interest to the agricultural chemist. One is the decomposition of cellulose with ultimate production of the black material known as humus; the other is the conversion of the protein and other nitrogen of the soil to nitric nitrogen.

The first change is only slightly understood; a plausible assumption for which there is some direct evidence is :—Cellulose, > levulose, > hydroxymethylfurfuraldehyde, which in presence of acids, e.g., amino acids, condenses to form humus. The second change is better understood. The complex compounds break down to form ammonia, which oxidizes to nitrites and finally to nitrates. The agents bringing about the change are bacteria, and probably certain fungi; the production of ammonia is a widely spread property; it is not usual to identify the organisms concerned, but only to count them. The production of nitrite and nitrate is more specific and is confined to two or three species. Nitrates are an essential plant food and their production is indispensable to the plant. But the population is very mixed and some agents—presumably some of the organisms—remove part of the nitrate as soon as it is formed, either decomposing it, or more probably assimilating it and converting it into protein. Much light has been thrown on this process by a new method of investigation now in use at Rothamsted. Samples are taken from the field every two hours and determinations are made of the bacterial numbers and the nitrate. In the earlier work the ammonia also was determined, but its amount was always so small and so little subject to variation that the estimations were discontinued. In the cases so far examined the bacterial numbers and the nitrate show marked fluctuations, the nitrate following the bacteria up and down with a lag of about an hour.

The cause of the fluctuation in nitrate is the fluctuation in bacterial numbers: the experiment throws no light on the reason for this, but information is obtainable from another experiment. Counts have been made daily of bacteria and amœbæ in the soil for a period of 365 days; both fluctuated, but always in opposite directions—when the amœbæ were high the bacteria were low, and *vice versa.* Presumably the fluctuations in bacteria are caused by the fluctuations in amœbæ; but why the amœbæ should fluctuate we do not know; perhaps they are affected by some other organism in a way not yet known to us, or perhaps there is some internal cause.

While the upward movement of nitrate is the direct result of the upward movement of the bacterial numbers the downward movement can hardly be the direct consequence of the fall in numbers: presumably it is due to the operation of a destructive factor or organism such as had to be postulated to account for other Rothamsted results. It was found that the production of nitrate in the soil goes on steadily year after year when there is no direct addition of any nitrogen compounds to the soil: the stock of complex nitrogen compounds originally present seems sufficient to last for a very long time. Nitrate is being washed out from the drain gauges at an apparently uniform rate of 1 lb. of nitrogen per inch of rain, although for 50 years no nitrogen compounds have been added to the soil. No known hydrolysis of protein compounds could produce ammonia in this way, and the results lead to the conclusion that part of the nitrate formed at any time is assimilated by micro-organisms, converted into protein, and then reconverted into ammonia and nitrate when they die. Recent work suggests that the amount of nitrate assimilation is much greater than was suspected. In a single day the amount of nitrate produced corresponded to 35 parts of nitrogen per million of soil, or 80 lb. nitrogen per acre—as much as is required in a whole year by a 45 bushel crop of wheat; but in consequence of the destruction also going on, the whole of this nitrate had disappeared before the end of the day and the net gain was *nil*.

There is reason to suspect that algæ may be concerned in the removal of nitrate—which in this case would be by assimilation, but other organisms may operate also; the matter is receiving close attention at Rothamsted. From the point of view of microbiology it is of course essential to investigate as fully as possible these remarkable relationships.

Besides these organisms concerned in the nitrogen nutrition of the plant, there are others that affect the health of the plant, causing injury or disease. We must now look upon the soil population as being both numerous and varied.

From the practical point of view it would be an obvious advantage to be able to control this soil population, and a beginning has been made here also. It is found that an improvement in fertility is obtainable when the soil population is simplified, as can be done by partial sterilization by steam or organic poisons. The difficulty that the soil might become sterile through the action of the poison on the plant is obviated in practice by the interesting fact that certain of the soil organisms possess the remarkable power of decomposing such unlikely substances as toluene, naphthalene, phenol, cresol, and apparently even the chlorcresols, rendering them innocuous to the plant. These problems are all receiving attention at Rothamsted and elsewhere.

The rest of the four problems arising out of farmyard manure are also receiving attention, and already the scientific interest is considerable. We cannot help wondering whether these new problems associated with the nutrition of plants: the elements needed in minute quantities only; the influence of cellulose or its decomposition products on nitrogen fixation; the effect of farmyard manure on the soil population and on the soil colloids—whether these will turn out to be as important as the one that filled the vision of the 19th century workers; and whether when developed they will lead to the establishment of great industries like the arificial fertilizer industry, and to great agricultural developments like those resulting from the use of artificial fertilizers. The signs are hopeful, and there seems to open before us a vista of possibilities which if we could but grasp them would heal many of the ills from which we are now suffering.

The sugar industry of Honduras (according to a British Consular Report) ranks second in importance to the banana trade in that country's industrial development, and promises to figure more prominently in the future. Cultivation on a large scale is confined to the north coast areas, and the most important factories are owned by American interests. The export of sugar during 1918-20 was as follows:—1918-19, 7823 short tons valued at $1,021,416; 1919-20, 5621 tons, valued at $1,156,532.

An installation was recently described by E. BUDAN[1] in which the waste gases from the top of the sulphitation apparatus (ordinary permitted to escape into the air) are forced by means of a steam injection into a pipe leading to the defecating tanks. These waste gases are forced into the juice in the defecating tanks through perforated branches, so that not only is the SO_2 utilized, but the stirring of the contents of the tanks is effected. Further, as the sulphitation apparatus is operated under a slightly reduced pressure, loss of SO_2 through leaks is prevented.

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[1] *Journal des Fabricants de Sucre*, 1921, 62, No. 29.

Kelham Beet Sugar Factory.

Some Particulars of its Installation.

Kelham has just finished its first campaign; and it would seem of interest now to give some particulars of the technical installation of this beet sugar factory. This the writer is able to do owing to the courtesy of Mr. ALFRED WOOD, the able and energetic secretary of Home Grown Sugar, Ltd., who, on the occasion of a recent visit, afforded every facility for the inspection of the plant and willingly supplied the fullest necessary information.

Some details have already been given from time to time regarding the installation at Kelham.[1] It is unnecessary to repeat these, though the reader may be reminded that its capacity is 60,000 tons of roots during the season, or about 600 tons per day of 24 hours, the total production being estimated at 8000 tons of sugar, 3000 tons of dried pulp, and 1800 tons of molasses.

The plant was designed and supplied for the greater part by the Cie. de Fives-Lille, of Givors (Rhône), France. It is of interest to note that the Commission appointed by the French Government to investigate the problem of the re-building of the factories which had been destroyed during the war advised erection according to a standard equipment for the purpose of the most economical construction; and that Kelham has been built according to the standard design approved by the Commission. It has been, in fact, the first factory to be erected according to these plans.

SITE AND BUILDINGS.

A few particulars may be stated regarding the site and the buildings. The factory has been erected on the Kelham estate, which covers 41½ acres, and is owned by Home Grown Sugar, Ltd., the company thus being able to cultivate a portion of the beet crop on its own land. It is advantageously situated for the delivery of roots, coal, and limestone by both water (using the Trent) and rail (by the Great Northern and Midland lines).

The principal building comprises the main machinery hall (280 ft. × 47 ft. × 54 ft. high to ridges); the cossette press annexe of three floors (72 ft. × 24 ft. × 62 ft. high); a mixers annexe (72 ft. × 24 ft. × 30 ft. high); the filter-press department of two floors (59 ft. × 48 ft. × 62 ft. high); the pulp drying room (73 ft. × 47 ft. × 46 ft. high); the sugar store (73 ft. × 72 ft. × 46 ft. high); and the boiler-house (84 ft. × 57 ft. × 42 ft. high). The out-buildings comprise the dried pulp store (72 ft. × 48 ft. × 39 ft. high); the lime-kiln (48 ft. × 24 ft. × 51 ft. high); the machine shop and store (72 ft. × 66 ft. × 28 ft. high); and the Customs offices; tare office; weigh-bridge offices; coke and locomotive sheds; and general offices.

PROCESS OF MANUFACTURE.

Washing department.—Most of the roots arrive at the factory by rail and road, and are dumped directly from the trucks or carts into six silos (of ferro-concrete, each measuring 20 ft. × 328 ft.), the total capacity of which is about 5000 tons. From the silos the roots are transported to the factory in the usual manner along flumes until they reach an elevating wheel, the diameter of which is 8 metres. Steel buckets suspended from the inner rim of the wheel raise the roots into the factory, depositing them in the washer, a semi-cylindrical trough containing water, provided with a revolving shaft with wooden arms which stirs the roots and gradually propels them from one end of the apparatus to the other. On leaving the washer, the roots pass successively a weed separator and a stone catcher. Thus cleaned, the raw material is raised to the slicing department, which is situated in the highest part of the building. At this point it may be mentioned that the sucrose content of the roots delivered to Kelham averaged in the earlier part of the season 16·5 per cent.

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[1] *I.S.J.*, 1920, 193, 635; 1921, 190, 605.

Slicing department.—On arriving at the top part of the factory by a bucket elevator, the roots are first weighed in a "Chronos" machine, which automatically records the amount passing through the scales (400 kg. at a time), giving a figure which forms the basis of the chemical control of the manufacturing operation. From the weighing machines they fall into the slicing apparatus, which is of the Maguin type, consisting of a drum with a horizontal shaft, the knives being fitted on the periphery. This slicing apparatus gives good long cossettes having a thickness from 1 to 1½ mm.

Extraction of the juice.—On leaving the slicing machines, the cossettes fall into a worm conveyor by means of which they arrive at the battery of diffusion vessels, which at Kelham number 14, arranged in two parallel rows of seven each. These vessels are provided with an upper filling door and a bottom discharge, both of which doors open and close on rubber joints by hydraulic action. Each has a capacity of 55 hectol., and 50–57 kg. of slices are introduced per hectol. A heater is placed between every two diffusers, it being capable of raising the temperature of the juice in circulation to about 75°C. as required. During this season the juice drawn off the diffusion battery has averaged about 110 to 120 per cent. on the roots, its purity and sucrose content being 87·3 and 12·34 respectively. On leaving the diffusion plant, the juice is freed from fine pulp by passing through a screening apparatus of fine gauze, after which it enters measuring tanks provided with an automatic recording device. It is then ready for the process of clarification by carbonatation.

Beet pulp.—As the cossettes or slices in each diffusion vessel become exhausted, they are allowed to fall into a pit below from whence they are raised by a special pump to the slice presses, in which the water is expelled so as to give after pressing a product containing about 16 per cent. of dry substance. Continental factories sell more or less of their pressed pulp as such for cattle food, but at Kelham a fine plant for the production of saccharine dry pulp has been installed. The slices from the presses are incorporated with a suitable proportion of molasses, and passed into the slice dryer, which utilizes for its operation the waste boiler gases, and in addition may be directly heated. This dry pulp has been put on the market under the name of "Sugabetix," and the farmers of the district, and many in more remote parts of the country, are now appreciating its great value for the fattening of their cattle. It has approximately the following composition: moisture, 11·80; sugars, 22·40; proteins, 8·59; fibre, etc., 51·60; and ash, 5·70.

Clarification of the juice.—The diffusion juice coming from the battery has a density of about 14·14° Brix. It is clarified by the double carbonatation process. In the first operation it is treated at 80°C. with 2·5 to 3·0 per cent. of lime in the form of milk at 20 to 25° Bé., this addition cooling the juice to about 75°C., at which temperature treatment with carbon dioxide is effected. Gassing is continued to an alkalinity of 0·08 to 0·10, and the juice passed through filter-presses of a well-known type, in order to separate the precipitate of scums which has formed. In the second carbonatation, a further addition of milk-of-lime is made after re-heating, this time using only about 0·25 per cent., after which gassing is carried out until the alkalinity of only 0·005 to 0·015 is reached. After the juice has passed through mechanical filters (of the Danek type), which render it quite limpid, it is ready for the evaporating station. There are four carbonatation tanks, the capacity of each being 100 hectol. The scums separated in the filter-presses are washed with water to a sugar content of about 0·18 per cent.

Evaporation of the juice.—The concentrating plant is a quintuple effect, utilizing the exhaust steam from the power engines of the factory, and in addition live steam at 160 lbs. pressure. On leaving the quintuple evaporator, the syrup is sulphited slightly using a Quarez oven, and sent through mechanical filters. Heating surfaces of the five vessels are 375, 335, 160, 110, 110, sq. m., a total of 1090. Vapour from first vessel, also from second if needed, is withdrawn for supplying reheaters and diffusers.

Boiling of grain and centrifuging.—Thus treated the syrup is boiled to grain in the first pans, the masse being fed after graining with liquor obtained by the re-melting of the second sugar. There are two first pans, the capacity of each of which is 250 hectolitres, their heating being effected by vapour taken from the second unit of the quintuple effect. There are nine mixers, four first yields, five second yields, 300 hectol. This first massecuite is cooled in mixers, and passed to the battery of Watson Laidlaw centrifugals of which there are six for the first and second sugars. The molasses separated from this first massecuite is boiled to grain, cooled, centrifuged, and this *sucre roux* re-melted, and used (as stated) for feeding the first product strike. The liquor from the second sugar constitutes the final molasses which is mixed with the pressed pulp in the manner already described. There is one second pan, having a capacity of 250 hectol. of massecuite. During the first part of this season, the white sugar made at Kelham was hardly up to standard (as one might perhaps expect at the commencement of the campaign in a new factory), but later its quality was improved. That being bagged and weighed at the time of the writer's visit was a very fair granulated, suitable for direct consumption. All sugars were well above 99 polarization, the lowest 99·50 and highest 99·90.

Power plant.—The boiler-house at Kelham is a particularly well equipped installation. There are four Stirling boilers of 170 lbs. per sq. in. working pressure, which are provided with underfeed stokers (class A) and a travelling grate. Only two men per shift are required for the operation of this department.

These four boilers drive: four Corliss expansion engines (ranging from 180 to 300 H.P.), working (1) washing room, juice extraction, and clarification plant machinery; (2) mixers and centrifugals, condensation pump, and lighting dynamo; (3) dynamo, carrying power to special or distant machinery, as lime plant and pulp drying plant; and (4) gas and air pumps. In the engineering shop the power plant consists of a Ruston-Hornsby heavy oil engine of 30 H.P. with hot bulb ignition for driving the machines; and a 30 k.v.a. dynamo for lighting the shop, and as a stand-by for the factory lighting in the case of a break down during the campaign, and for all lighting during the off-season.

Chemical control.—There is a well-equipped laboratory under the direction of a French chemist, M. Hot, who is assisted by students of Nottingham University.

General.—Kelham factory is under the management of M. Henri Thiery, a well-known French beet technologist. During this season, 25,000 tons of roots have been sliced; and in the early part of the campaign some difficulties, such as one might expect in the starting of a new plant, have been encountered. It is hoped that next season Kelham, despite its present financial difficulties, may be operated to its full capacity, namely 50,000 to 60,000 tons, and technically with the best possible results.

Report on the Manufacture of Sugar and Utilization of By-Products in Hawaii.

The Committee appointed by the Hawaiian Sugar Planters' Association to report upon the progress made in the manufacture of sugar and the utilization of by-products for the year ending September 30th, 1921, consisted of Messrs. S. S. PECK (Chairman), J. N. S. WILLIAMS, J. P. FOSTER, R. D. MOLLER, H. B. PENHALLOW, W. SEARBY and W. R. MCALLEP. The following is a summary of their report:—

MILLING.

Our methods of milling have been the subject of extensive reports by Javan engineers visiting the territory. Their reports have been published in the *Archief* and have been translated by Mr. W. F. DUKER, and are submitted as part of the present report.[1] Our methods both of operation and control are rather severely criticized. It is open to argument whether the strictures and criticisms of these writers are justified, but it is hoped that their conclusions will be thoroughly studied, and perhaps tested out, by factory operators during the next season.

The mill of the Hawaiian Commercial and Sugar Co. has operated this year as a 15-roller unit, and the results obtained are described by Mr. WM. LOUGHER, mill superintendent, as follows:

During 1920 the 15-roller train was more or less in the experimental stage, and was used but 20 per cent. of the time; but in 1921 more than 99 per cent. of the crop has been ground by it. The following figures show the gain in extraction and capacity due to this installation:

	1920 CROP			1921 CROP, to Aug 20, 1921	
	12-Roller Mill A	12-Roller Mill B	15-Roller	Mill A, 12-Roller	15 Roller
Tons cane per hour	54·41	52·10	77·53	54·65	67·98
Polarization in cane, per cent	16·09	16·19	15·12	13·06	15·58
Fibre in cane, per cent.	10·51	10·36	10·74	12·50	11·61
Polarization in bagasse, per cent.	1·00	1·00	0·80	0·84	0·71
Moisture bagasse, per cent.	40·08	39·01	43·05	41·26	42·13
Dilution	48·00	49·80	30·10	37·00	36·30
Extraction	98·88	98·93	98·98	98·59	99·07
Extraction ratio	0·105	0·10	0·095	0·11	0·08
Milling loss	1·72	1·69	1·44	1·47	1·26

Comparing the fifth column with the first and second, it is seen that while grinding more tons of cane per hour, with over 1 per cent. higher fibre, and using approximately ¾ of the dilution, the 15-roller mill obtained about 0·2 per cent. higher extraction. But to this advantage should be added the saving in fuel, labour, lubricants, etc.

During the past decade the percentage of sucrose extracted by the mills has been steadily rising, until this year there are several factories reporting 99 or close thereto. The question has naturally arisen as to whether such high extraction is a paying proposition; that is, whether there is a compensating proportion of the sucrose extracted at the higher limits placed in the bags. This must be considered principally from two points of view:

1. The quality of the extra expressed juice. We know the purity of the last mill juice, but we do not know that of the expressed juice which may be responsible for a further 0·5 per cent. in the extraction. Nor do we know the nature of the

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[1] Summaries of two of these papers will be published later.—ED., *I. S. J.*

impurities in this juice, or even in the whole last mill juice. As extraction proceeds from mill to mill, the glucose, ash and gums are extracted in addition to sucrose, but in changing proportions, due to the added water and heavier pressures. Thus taking data from PRINSEN GEERLIGS' "Cane Sugar and its Manufacture," for juice obtained in Louisiana and Java from triple crushings without maceration the first mill juice has its constituents, sucrose, glucose, ash and gums in the proportion of 100 : 12·0 : 1·7 : 0·76; the second mill 100 : 9·6 : 2·58 : 2·30; and the third mill 100 : 9·6 : 2·61 : 7·82. That is, the rate of glucose to sucrose has decreased from the first mill; the ratio of ash to sucrose has increased 50 per cent. from the first to the second, and about the same to the third mill; but the ratio of gums has increased 200 per cent. from first to second, and 900 per cent. from first to third. There is a very great increase of the undesirable impurities, ash and gums, over the proportion existing in the first mill. At the same time the glucose decreases or remains about the same. If both ash and gums increase the viscosity, and interfere with extraction, it would appear that the recovery from the last juices must be below that from the first; and that calculations of recoverable sugar from these juices should not be referred to average molasses purities. In addition, it must be remembered that in Hawaii we are dealing with quadruple crushing and heavy maceration, and the conditions illustrated above for Louisiana and Java may be still worse under our conditions.

2. The cost of evaporation of maceration water, where extra fuel must be consumed for this purpose. Here the relative values of sugar and of fuel oil are of particular significance, and a contribution from Mr. HERBERT WALKER, mill superintendent of the Pioneer Sugar Co.'s factory, shows the connexion.[1] Mr. WALKER has also calculated the possible financial losses resulting from the use of excessive amounts of water in sweetening off press-cake, and in diluting molasses for subsequent boiling. In the case of press-cake washing a further important consideration is the purity of the last washings. In some instances, where a low polarization of cake is reported, this has been found to be connected with long continued washing of the presses, during which time there has been either destruction of the sucrose or re-solution of the impurities from the cake. In both cases an extremely low purity of the final washings has resulted. It is obvious that whether extra fuel is burned or not for the extra evaporation, such procedure does not spell any financial advantage to the factory.

CLARIFICATION.

In the report of the Committee for 1920, mention was made of the solubility of "cush-cush" in juice, the rate of solubility increasing with the alkalinity of the juice, the dissolved substance being called in a general way "gums." Experiments conducted at the Experiment Station show that purity is materially affected by the presence of fine trash during clarification, the conclusions being:—

> It can be stated that if "cush-cush" is present when juice is limed and heated, part of it goes into solution, adding to the impurities in the juice with the result that the increase in purity secured during clarification is less than it would have been had none been present. Heavy liming of the settlings, from the same point of view, is an objectionable practice, for the greater part of the "cush-cush" that was in the mixed juice is concentrated in these settlings and conditions are favourable for dissolving further portions of it.
>
> It is calculated that a depression of 0·2° in syrup purity is a reasonable assumption. According to the accepted formula, this alone would be responsible for a loss of over 1000 tons of sugar in the 1920 crop. But if the dissolved impurity finds its way entirely into the final molasses, using 1920 figures, this would indicate a difference of 1·09. Again

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[1] We hope to publish this very useful paper next month.—ED., *I.S.J.*

using the formula, this is an indicated loss for the 1920 crop of 3750 tons of sugar. The calculation may seem to be far-fetched, but it is an indication of the losses that may be occurring due to a small increment of impurity in the mixed juice. It amounts to 6·6 tons sugar per 1000 manufactured, which should be sufficient to warrant investigation.

Mr. WALKER states that toward the end of the season he replaced the coarse screen over the mixed juice receiving tank at the mill by a fine screen made from heavy, slotted centrifugal screen. The following figures compare the six weeks' run using the fine screen with the six weeks' run just preceding:

	Coarse Screen.	Fine Screen.
Weight of cake, per cent. cane	3 29	2·77
Polarization, per cent. cake	0·51	1·88
Moisture, per cent. cake	79·4	74·3
Polarization lost, per cent cane	0·0168	0 0524
Gallons wash water, per ton cake	370	558
Increase in purity, mixed juice to syrup	0·49	0·55
Decrease in purity, crusher juice to syrup	2·34	3·74

Attempts to improve poorly filtering mud by the addition of fine trash have generally not been successful, but according to the above comparison of 6-week periods, screening the juice and reducing the mud per cent. cane from 3·29 to 2·77 has been decidedly harmful to the mud-press work. Although more care was taken at this station than usual and more wash water used, it was impossible to wash the cake as free from sugar as before It may be that the increase in mud due to better milling consisted largely of very fine particles of "cush-cush," while that taken out by screening was, of course, the larger pieces.

The advantages of screening are not so apparent. Operators at the settling tanks say that on the whole the clarified juice was brighter and clearer. As the clarified juice is all passed through a 100-mesh screen anyway, a preliminary straining of the raw juice could not have much effect on the amount of "cush-cush" passing into the syrup No difference was noticeable in the behaviour of syrups and molasses during boiling and purging. The increase in purity from mixed juice to syrup was very little more on the fine screened juice, while the drop from crusher juice to syrup was much greater; but the screens can hardly be blamed for this drop in purity.

Summing up the evidence for and against screening the mixed juice, we find a positive disadvantage in poorer work at the presses, while the practical advantages are so far still unproven.

CLEANING EVAPORATORS.

Owing to the slow rate of grinding, there has not appeared any real necessity for changing methods of removing evaporator scale. Some factories have discarded the use of caustic soda entirely, finding boiling with dilute acid sufficient. Others use only soda, followed by scrapers; while there are others again continue the old custom of caustic soda followed by acid. The Experiment Station reports tests on the solvent effects of various solvents alone and in combination. The best results were obtained by boiling with a 1 per cent. solution of soda ash for 30 mins., followed by muriatic acid. In a Philippine factory excellent results followed the same procedure, but using 3 per cent. soda ash solution. This method has the great advantage of cleaning tubes without the need of manual labour, also eliminating the danger of damage to tubes from clumsily handled scrapers. It has the disadvantage of requiring a high concentration of soda ash solution, because of the limited time in which the boiling must take place.

BOILING.

The few replies received would indicate that no particular trouble has been experienced in producing a high polarizing sugar. There has been naturally more low-grades to be handled, but the increase between a 96 and 97° sugar has not been sufficient to cause any disturbance. There has been a very decided retrogression in the size of grain in the commercial sugars from a large number of factories. It is charitable to assume that this has resulted from the generally disturbed conditions in the factories following irregular cane supplies and stoppages, quality of labour, etc.; but the Committee is more inclined to believe that it is primarily due to either carelessness or lack of interest in those responsible. It is strongly urged that every effort should be made towards producing a sugar with less small grain than obtains in the majority of factories at present.

BY-PRODUCTS.

Due to labour conditions, the advantages of press cake as fertilizer have been largely lost, many irrigated plantations finding it necessary to get rid of it by distributing it in irrigation water. It doubtless has some usefulness when disposed of in this way, but nothing approaching the benefits following application before cultivation.

The erection of several alcohol distilling plants is being considered, and the unsatisfactory nature of the molasses sales to the Coast should encourage its utilization in some manner locally.

At Kahuku Plantation factory the method of using molasses as fuel is of interest, and is described by the chief engineer, Mr. H. K. SCHOLEFIELD, as follows:—

The furnace has a flat grate of the rocking type, with an area of 30 sq. ft. Centrally located about 8 ft. above the grate, a cast-iron roller extends the full width of the furnace. Upon this roller 8 funnels direct an equal number of streams of cold final molasses. The cast-iron roller is made up of the following parts: a hollow cast-iron shaft is supported by large pedestal boxes and receives motion through chain and sprocket drive. Upon the square section of this shaft there are mounted 16 cast-iron discs. Each pair of these forms a support for one cast-iron rim. Eight of these rims grouped together form a corrugated roller 28 in. in diam. The rim elements are retained in position by circular distance pieces at each end of the group, backed up by circular nuts screwed over the central shaft. The opening through the hollow shaft is closed at one end with a standard 5 in. plug which offers easy access for internal cleaning, and at the other end by a cap having a stuffing box through which the inlet and discharge circulation pipes are carried. Through this arrangement a constant circulation prevents damage to the central shaft.

The furnace must first receive a preliminary heating by burning one full charge of firewood on the grates. As soon as the wood is enveloped in flames the roller is put in slow motion and a small stream of molasses allowed to enter each funnel through suitable manifold pipes, each stream being governed by an individual valve. The molasses falling on the roller adheres thereto, and its moisture content becomes immediately lowered through evaporation. Within a short time the roll becomes covered with a mass of coke, lumps of which begin to fall through excessive weight. These falling masses are consumed to ash on the grates, where they give off an intense heat which, being reflected by the furnace, walls, and arch, maintains the roll and its burden of partly consumed coke in an incandescent state.

The furnace was originally designed to operate with two rollers, but the depreciation of discs was very great, whereas with one roller it is negligible. The capacity of a 6 × 18 H.R.T. boiler set over this furnace is normally 125 H.P. per hour, but has run very much over on peak loads. An average of 3 lbs. of water has been evaporated by 1 lb. of final molasses of 94° Brix over 24 hours. Experiments in pre-heating the molasses prior to entry into the furnace have indicated that cold molasses is handled to better advantage, as when hot it fails to adhere to the roll. We have designed and contemplate the use of a water curtain to intercept the large quantity of potash which now escapes up the flues. The ash from the grates is soluble and is applied in irrigation water to the fields. In this ash we estimate there are about 30 lbs. of potash per ton of molasses burned.

Recent Work in Cane Agriculture.

THE LINEAR BUG, *Phaenacantha australica* KIRKALDY : A NEW PEST OF THE SUGAR CANE IN QUEENSLAND. *F. J. Illingworth. Bureau of Sugar Experiment Stations, Division of Entomology, Bulletin No. 14, Brisbane, 1921.*

This insect was found to be extremely abundant on *Imperata arundinacea* in September 1917 when sweeping for insects : in the beginning of 1918 it was noted as numerous along the grassy headlands of cane fields : in August it was observed in such numbers on cane leaves that they turned yellow, while in September they simply swarmed over the trash when the canes were cut. This reminds one of the chinch bug in the United States, which belongs to the same family. That pest was at first noted on wild grasses but, turning to cereal crops, it ultimately caused damage to the extent of $100,000 in 1874. Like the chinch bug, the linear bug appears to be gradually changing its habits and invading the cane fields along the grassy headlands. It hibernates in the bunches of grass and cane trash and its habits generally resemble those of the chinch bug. The eggs are similar and scattered about on the soil at the roots of grasses. Fortunately it suffers from analagous natural checks.

The linear bug has a mosquito-like beak, easily puncturing the leaf and sucking the cell sap. It is normally found on the underside of the leaves, and when hungry remains in position while being examined under the lens, every now and then shifting its proboscis to a new place. The punctures are extremely numerous and very minute, and it is easy to imagine the damage done when the bug is present in such myriads : the leaves turn yellow and ultimately brown when disease germs enter the punctures.

The bulk of the bulletin deals with observations as to the various stages in life history, which however has not yet been completely worked out. The damage may well become as great as that of Perkinsiella in Hawaii, when it was accidentally introduced without its natural enemies, rendering the canes ultimately hardly worth cutting. Certain varieties appear to be specially liable to attack, e.g., *Clark's Seedling* and *Badila*, whereas it affects *D 1135* comparatively little. The main enemies are ants, an undetermined fungus in wet weather and a large reduviid bug, and these seem to have at present a fairly effective control. The obvious method to be adopted if the pest becomes serious is to clean up grassy headlands and borders, thus depriving the eggs and young nymphs of shelter : also burning grass paddocks as early as possible to prevent the maturing of the insects : spraying with arsenic may be tried, but care must be taken lest this action should also destroy the enemies of the pest (as was done at first with froghopper in Hawaii) : lastly the trash may be burnt, but this should be avoided if possible because of its importance in the formation of humus.

P.O.J. 2714 AND P.O.J. 2725, NEW JAVANESE VARIETIES OF SUGAR CANE OBTAINED BY CROSSING : THEIR INTRODUCTION INTO COCHIN-CHINA. *F. A. Erkelens. Bulletin de l'Office Agricole de l'Institut Scientific de Saigon. Vol. II, 9, pp. 278-282. Saigon, September 1920.*

Cuttings were established of these two canes in the Phu-My Station in Cochin-China, and the present bulletin gives a detailed analysis of the origin of the two seedlings which are of identical parentage. The female parent was *P.O.J. 2364* and this was crossed by *E.K. 28* as male. *P.O.J. 2364* was a cross between *P.O.J. 100* and *Kassoer*. The former was a cross between *Borneo* and *Louzier* and the latter was found by SOLTWEDEL at the foot of Mt. Tjerémé in the Cheribon

Residency of Java. It is thought that *Kassoer* is a natural hybrid between *Cheribon* and *Glagah* (*Saccharum spontaneum*). *Glagah* is extremely resistant to sereh and has hitherto always passed on this character to its descendants, and *Kassoer* shares the resistance. Both *Glagah* and *Kassoer* have an extremely low sucrose content. *E.K. 28* is probably a cross between *Bandgermasin-hitam* and *Fiji*: the former appears to be the same as the *Borneo* mentioned above and *Fiji* has been known in Java since 1891. The characters of the two introduced canes are gone into in considerable detail and show satisfactory richness in sucrose in the juice: they appear to be early canes as both of them ripened within twelve months.

THE MINOR SUGAR CANE INSECTS OF PORTO RICO. *George W. Wolcott. Journal of the Department of Agriculture of Porto Rico. Vol. V, No. II, April, 1921.*

In a short introduction the author points out that, while the insects causing noticeable and serious injury to the cane in Porto Rico have received much attention, those causing slight or no injury but living upon the cane have been almost entirely neglected. But the minor insect pests may prove to be of considerable importance because of their possible connexion with the rapid spread of the mosaic disease in the island. The following are the essential characters of an insect capable of such action:—(1) It must occur in abundance on the sugar cane in all parts of the island where and at the time when the disease is spreading. (2) It must be capable of more or less rapid spread or dispersion, either by itself or by other insects or agencies. (3) Presumably it should be an insect with mouth parts adapted to piercing live healthy cane tissue and sucking up the cane juices. (4) It should live on that part of the cane plant in which virus which causes the disease occurs. This part has been determined by Dr. BRANDES, in his successful transmission of the disease by the corn aphis, as the central whorl of tender growing leaves, and the author has therefore more or less concentrated on the insects found in this part. Of the four conditions all but the first can be readily determined, and the author lays out in some detail the difficulties of making certain with regard to this first character.

The detailed list of insects found on the cane during a six months' period of observation (December to June) is then proceeded with, with brief notices of occurrence and clear, striking illustrations in the text. This should prove of great service to those engaged, not only in the study of the mosaic disease but, as many of these insects may become more important at any time, in a full study of the cane pests of the island. A number of interesting remarks occur in the descriptive paragraphs. For instance, some of the insects at present of little importance in Porto Rico are noted as major pests elsewhere, such as the termites and the West Indian cane fly. Special attention has naturally been paid to the Hemiptera, because one of them, *Aphis maidis* (the corn aphis) has, as mentioned above, been proved to be capable of transmitting mosaic. This Aphis has not, however, been found on sugar cane in Porto Rico, so that it cannot in any way be considered as responsible for the spread of the disease. The Yellow Sugar Cane Aphis (*Sipha flava*), on the other hand, is one of the commonest insects on sugar cane in the island: the adults can fly and are carried for considerable distances by the wind; it has three of the necessary characters for possible transmission, but has never been found in the central whorl of leaves. The Sugar Cane Leaf Hopper of Porto Rico (*Kolla similis*) is probably the most abundant leaf hopper in Porto Rico, and it receives a great deal of attention from the author, without, however, his being able to bring a very strong indictment against it with regard to the spread of mosaic. The paper is a useful record, replete with interesting notes, and is a valuable contribution to the study of cane pests.

REPORT OF THE COMMITTEE ON STOCK FEED. *Hawaiian Sugar Planters' Association, for the year ending 30th September, 1921.*

Last year's report was dealt with in some detail,[1] and the present one may be regarded rather as an interim one, "as the Committee find it hard to enlarge upon or add to the complete and exhaustive report of 1920." There has, however, been a very important decrease in the cost of imported foodstuffs—28½ per cent. in hay, 28½ per cent. in barley, 38 per cent. in bran, and 48½ per cent. in middlings, although alfalfa meal remained unchanged. This fact will no doubt render the question of the islands being self-contained in stock feed of less immediate urgency. The majority of the estates apparently depend almost entirely on hay, barley, molasses, and alfalfa meal for the staple food of all working animals, supplemented by cane tops and molasses as roughage. In the off season the latter are usually replaced by such grasses and weeds as are available on waste lands and the borders of the cane fields. Experience with alfalfa has proved to the satisfaction of the Committee that its cost is prohibitive in labour and fertilizers. To keep up the yield—which is estimated at 37–40 tons of green stuff per acre per annum in Hakalau—it is necessary to apply fertilizer after each cutting, and although as many as 24 cuttings have been obtained successively without the necessity of re-sowing, a great deal of labour is absorbed in keeping it clean. Pigeon peas, guinea and elephant grass are accordingly being experimented with as substitutes. The feed ration for work cattle per head per day is as follows:—8 lbs. hay and 42 lbs. cane tops, in addition to 10 lbs. rolled barley, 2·11 lbs. molasses and 0·92 lb. alfalfa meal, thoroughly mixed in a special manner. A series of letters from individual planters follow, many of which contain interesting details.

C. A. B.

Odoriferous Substances of the Beet, and their Separation.[2]

By K. ANDRLIK.

It is known that during the war "marmalades" having no "beety" odour were manufactured from beets, this odour having been lost during the process of boiling down, thus demonstrating that the substances which contribute to the characteristic smell are of a volatile nature.

In investigating the isolation of these substances, I first tried to free raw and diffusion juice from their volatile aromatic constituents by simply boiling, the vapour evolved being condensed. These experiments, however, failed, on account of the strong frothing over of the juice into the cooler and receiver.

Accordingly, further experiments were instituted with thin slices cut from the roots. Steam at a pressure of about 0·5 m. (water column) was admitted into the lower part of a cylindrical vessel, above the bottom of which was a shelf of wire gauze, a tube fitted with a cock being also provided for carrying off any liquid collecting. The upper part of the vessel was equipped with a flange to which a copper still-head was screwed, this being connected with an inclined brass Liebig's condenser. The space from the wire gauze to the upper edge of the vessel was filled with 5 kilos. of the roots cut in slices.

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[1] *I S.J.*, 1921, pp. 202-203.

[2] Abridged translation from the *Zeitsch. Zuckerind. cechoslov. Republik*, 1922, 46 (iii), No. 20, 201-205; originally published in *Listy cukrovarnické*, 1921-22, 40, 77. In view of the experiments which have been carried out during the past few years in America, France, and Germany with the object of preparing a palatable table syrup from beets, these results obtained by Mr. ANDRLIK are of much interest. They suggest a means of obtaining a syrup free from the objectionable "beety" odour. Probably, however, the disagreeable taste would remain, though masked to some extent by the sweetness of the invert sugar formed by inverting the sucrose during the manufacture of the syrup.—Ed., *I.S.J.*

When the vessel had been heated up, the steam passed over into the cooler, and condensed to a colourless distillate, which was preserved in a stoppered container. This distillate had a strong smell of beet. Steam distillation was continued until the last portions of the condensate were free from smell of beet, having instead a slight odour resembling furfural. Before the odour could be eliminated from the slices in the vessel, it was necessary to continue the distillation until the weight of the condensate was about equal to that of the beets worked. In this way it was possible to separate almost all the odoriferous substances from the beet, and to collect them in the very dilute aqueous distillate.

The question was now to concentrate these odoriferous substances. The 5 litres of distillate was admitted to a second distillation, which showed that it sufficed to collect 1-2 per cent. of the volume of the original distillate in order to free the liquid from any smell of beet. The odoriferous substances were therefore very volatile in steam.

This second distillate had an intense odour of beet, and upon its surface there were drops of a liquid which finally united into an iridescent layer. This upper layer could be separated in a funnel to a large extent from the aqueous portion, which, however, still smelt strongly.

In order further to concentrate the odoriferous constituents, the second distillate was shaken out with ethyl ether, by which they were readily taken up. This ether extract was distilled on a water-bath at 45° C. It was observed that if the temperature were allowed to rise above 45° C., namely to 46–48° C., the odoriferous substances passed over into the distillate. Therefore, the distillation was conducted throughout at 45° C. In the distillation flask there remained about 0·5 c.c. of a residue separating into an aqueous and an oily portion, the amount of the latter being about 0·25 c.c. After completely driving off the ether, the liquid possessed a strong odour of beet, with a peculiar aromatic, balsamic after-smell.

It was thus established that the substances which give its smell to the beet can be isolated in a highly concentrated state. One can estimate their approximate amount in the beet to be 0·005 per cent. With the steam, some volatile acids also passed over, the acidity of which towards phenolphthalein was equivalent to 0·5–0·6 c.c. of N/1 NaOH per 100 grms. They appeared not to be in the free state, but rather in the form of an easily saponifiable compound.

Moreover, some nitrogenous substances passed over, the nitrogen content of which, however, was very small, amounting only to about 0·0005 grms. of N per 100 grms. of beets. These nitrogenous substances can hardly cause the smell of the beet, on the one hand because of their slight amount, and on the other because they remained for the greater part in the residue after the distillation of the first condensate, which no longer had any odour, while the second distillate, which smelt strongly of beet showed only a trifling nitrogen content (viz., 3·8 mgrms. in 5 kilos.)

The substances causing the odour of beet are not homogeneous. They consist of a portion volatilizing at a temperature below 70° C., and of another which passes over with steam only at about 100° C. Regarding their composition, nothing can yet be said. Possibly they are phenol compounds. Besides the constituents mentioned passing over the steam, vanillin, furfural, acetamide, some of the higher amines, and an undertermined waxy white substance, all in insignificant amount, were observed.

Value of Kieselguhr as an Aid in the Filtration of Cane Juices.

Kieselguhr, diatomaceous earth, or fossil meal, is a fine and exceedingly porous flour, composed of microscopic shells, the skeletons of minute water plants, called *Diatomaceæ*. It forms an extremely light powder (1 cub. ft. of the best grades weighing only about 10 to 14 lbs.); and it is to this property, and the very fine state of division of its particles that its recognized value as an aid to filtration is due. It is composed mainly of pure silica (SO_2), which is entirely inert to most chemical reagents.

Kieselguhr removes from suspension the finest particles, even those in the colloidal state, producing on filtration a brilliant liquid and an open cake. Sometimes, moreover, the colour of a product thus treated is improved to a marked extent.

APPLICATION IN SUGAR REFINING.

Hitherto in the sugar industry the considerable advantages of kieselguhr appear to have been utilized only by refiners, who after treating their syrups with lime and phosphoric acid in the blow-ups have found that the addition of about 25 lbs. per ton of raw sugar melted has a remarkable effect in respect of rapidity of filtration, brilliance of the liquor coming from the presses or Taylor filters, and lastly the ease and thoroughness with which sweetening-off can be effected. Some modify this method of working by pre-coating the filter-cloth with a layer of the kieselguhr, though generally the addition is made to the blow-up. Regarding the amount to be used, this is established by experience, and naturally depends upon the nature of the raw sugar being melted. Generally 25 to 30 lbs. per ton of raw sugar suffices to break up the slime of the precipitate, and form a porous and easily washable cake.

USE IN CANE SUGAR MANUFACTURE.

It is singular that so far the value of kieselguhr as an aid to filtration has not been realized to the extent that it merits by the raw sugar manufacturer. Experiments carried out in the West Indies, in Natal, Australia, and elsewhere, in factories experiencing more or less difficulty in the filtration of their slimy muds have shown that the addition of kieselguhr gives cakes that are much harder, and are capable of being washed down to a low sucrose content with ease. This has been done by the addition to the raw juice of about 2-7 lbs. of the kieselguhr per ton of cane, liming, heating, and subsiding being then carried out in the usual way. Such a method of working renders it unnecessary to add lime to the muds previous to filtration, which anyway is quite a faulty procedure, since it adds considerably to the colour of the filtrate as the result of the action of the lime on the "glucose." Some factories have obtained satisfactory results by adding the kieselguhr to the muds previous to their filtration; but on the whole the addition to the raw juice previous to defecation appears to be preferable. In syrup filtration the use of about 2 lbs. per ton of cane, has a marked beneficial effect on the efficiency of the operation.

"SUMA-CEL" GRADE.

There are a number of different grades of kieselguhr on the market at the present time; but it is safe to say that some (particularly those containing a high amount of clay) are totally unsuited for the filtration of sugar juices and syrups. Good results have been obtained by the use of the mark "Suma-cel,"[1] the value of which in practice has now been proved. Its content in silica is high, and the amount of its non-silicious constituents, such as iron and alumina, lime, etc., is well below the limit which should be specified for this product. Further, the price of this grade is moderate; and is such that its use in the manner indicated above forms an inconsiderable item of cost, while its great value in case of filtration and saving of sugar by the exhaustion of the press cake cannot be over-estimated.

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[1] It is sold by The Sugar Manufacturers' Supply Co., Ltd., 2, St. Dunstan's Hill, London, E.C. 3 (Cable Address: "Sumasuco, London"). Its present price is £9 per ton f.o.b. United Kingdom port, packed free in single bags.

Publications Received.

Beknopte Handleiding ten Dienste der Fabricatie Contrôle. [Manual for Use in Factory Control.] Bulletin No. 11; third edition. (Proefstation voor de Java-Suikerindustrie, Chemische Afdeeling, Semarang.) 1921.

Bulletin 11 for use in effecting chemical control according to the mutual scheme adopted in Java factories has now been revised; but it differs from the previous edition noticed a few years ago[1] in these columns, in that matters dealing with milling have now been omitted, having been included in a separate manual to be published later. It is devoted to precise instructions concerning the sampling of the various factory products, their weighing or measuring, and especially to their analysis. Neither the methods of sampling nor those of weighing or measuring here recorded call for special notice now, being already well known. It is pointed out that direct weighing of the juice is coming more and more into use in Java in preference to measurement. Filter-press scum is of course weighed directly, but when this is impracticable (as when the Kelly press is in use) a method of calculation using factors multiplying the amount of lime used in defecation or defecation-sulphitation is recommended, though no great accuracy is claimed for this indirect manner of estimation. Coming to the methods of analysis, one notes that Steuerwald's procedure is prescribed for the determination of sucrose by double polarization in juices, syrups and molasses, instead of the Herzfeld process almost generally employed in other countries. In the case of juice, for example, 50 c.c., previously clarified with basic lead acetate, are mixed with 30 c.c. of dilute HCl (1·10 sp. gr.) in a 100 c.c. flask; allowed to stand at laboratory temperature (20 to 25°C.), made up to the mark, shaken, and the inversion reading taken with the usual precautions, a special constant from a table here given being used for the calculation of the results.

It is also worth noting the method now given for the determination of the reducing sugars in the various products, as it differs from the volumetric procedure prescribed in the previous edition: 88 grms. of juice are treated in a 200 c.c. flask with 5 c.c. of neutral lead acetate, made up to the 200 c.c. mark with water, and filtered; 100 c.c. are placed in a 100–110 c.c. flask, treated with 4–5 c.c. of a 10 per cent. solution of sodium phosphate, the volume adjusted to the 110 c.c. mark, and the liquid filtered; 50 c.c. are mixed in a 250 c.c. Erlenmeyer flask with 25 c.c. of Fehling's solution, boiled for exactly 2 min., cooled by the addition of 100 c.c. of water; treated with 25 c.c. of 20 per cent. KI solution, and thereafter with 20 c.c. of dilute sulphuric acid (1 : 5), and titrated (without filtering off the precipitate) with N/10 thiosulphate, using starch as indicator in the usual manner. Alternatively, the better known method, in which the cuprous oxide separated in a Gooch crucible is dissolved in a solution of iron alum, and the reduction determined by means of standard permanganate solution, may be applied. Sugar in condensed and waste waters is estimated by Skärblom's reaction, which has already been described in these pages[2]; while for the SO_2 content of sulphur oven gases an apparatus devised by Reich and improved by Lunge, which we have also previously described,[3] is recommended. A feature of this manual is the detailed account given of the recording of the analytical data (13 separate books being specified), and the calculation of the results. This very thorough account of chemical control as now carried out in Java concludes with a list of the apparatus and reagents, which should be found in a well-equipped sugar factory laboratory; various tables; and a number of specimen forms for the reporting of the various results obtained.

A Popular Chemical Dictionary. By C. T. Kingzett, F.I.C., F.C.S. Demy 8vo.; vi+539 pages. Second Edition. (Ballière, Tindall & Cox, London.) 1921. Price: 21s. net.

It is explained in the preface to this book that the endeavour of the author has been to produce a work which will serve "as a general work of reference, not only to many practical chemists, but more particularly to that larger body of the public who . . . have occasion to deal in or take interest in the thousand and one subjects and substances of which descriptions are given." On the whole Mr. KINGZETT has discharged his task well, though we think that the book will be found less serviceable to "practical chemists" (who should be well acquainted with the original source of most of the data given) than to the general reader. It is a book which we would recommend to business men (e.g., merchants, brokers and shippers), who in the course of their affairs frequently desire information on chemical and physical matters of the kind so conveniently summarized here. We suggest that its value would be much enhanced if Mr. KINGZETT were to state, in the case of each commercial chemical, the railway and shipping regulations, especially where the "dangerous" nature of the product demands such. Further suggested improvements are that quite a number of the entries might well be omitted, their places being taken by matters of greater commercial importance; and that references to fuller information might advantageously be stated in the cases of the principal items.

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[1] *I.S.J.*, 1916, 570. [2] *I.S.J.*, 1920, 412. [3] *I.S.J.*, 1914, 390.

Cost of producing Sugar Beets in Utah and Idaho, 1918 - 1919. L. A. Moorhouse and S. B. Nuckols. Bulletin No. 963, U.S. Department of Agriculture, Washington, D.C., U.S.A. (Superintendent of Documents, Government Printing Office, Washington, D.C., U.S.A.) 1921. Price: 10 cents.

Estimates were taken of the cost of beet cultivation on 220 different farms in irrigated districts; and the following are the main facts elucidated: 75 per cent. of the growers produced beets at a cost of $11 per ton or less; and the average cost worked out at about $9·49 per ton. Labour constituted 69 to 75 per cent. of all costs, inclusive of land rent; while materials (manure, seed, and water) worked out at 7 to 10 per cent.; and insurance, taxes, overhead charges, etc., 17 to 30 per cent.

Jaarboek voor Suiker-Fabrikanten in Ned.-Indië: 1918-22. [Year Book for Sugar Manufacturers in Java: 1918-22.] (J. H. de Bussy, Amsterdam.) 1922.

This is the standard manual relating to the various commercial aspects of the sugar industry in Java; and it contains a large amount of information in a well-arranged form. Thus, there are recorded: legal matters, giving *inter alia* the numerous *ordonnantie* or decrees regulating the renting and purchase of land, its irrigation, and the control of the *sereh* disease; particulars regarding the Algemeen Syndicaat van Suikerfabrikanten in Ned.-Indie and the Proefstations; articles relating to the insurance of employés in factories; particulars of the Government of Java; and a list of the factories and estates, and data regarding them. To all interested in the important sugar industry of Java, this volume is an invaluable one.

Tractor Principles: Action, Mechanism, etc., of the Gas Engine Tractor. R. B. Whitman. (D. Appleton & Co., London.) 1921. Price: 10s. 6d. net.

Condensed Milk and Milk Powders. Otto F. Hunziker, B.S.A., M.S.A. (Published by the author, at La Grange, Illinois, U.S.A.)

Right Use of Lime in Soil Improvement. By Alva Agee, Secretary New Jersey State Department of Agriculture. (Kegan, Paul, Trench, Trubner & Co., Ltd., London.)

A plant for the manufacture of the decolorizing carbon known as "Darco" is being erected near Marshall, Texas, on an 85-acre site. It is believed that this material may be the standard decolorizing agent for sugar refining in the future, as boneblack is at the present time.[1]

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[1] *I.S.J.*, 1919, 253; 1921, 373.

Trade Notices.

Moendas para Cana de Assucar. Bulletin No. 100 of 1922. (Fulton Iron Works Company, St. Louis, Mo., U.S.A.). Free on application.

This is a well-edited technical Bulletin, published in Spanish, dealing with the Fulton milling installations, particularly crushers, pre-crushers, double crushers, mills and milling accessories. It is written on much the same lines as Bulletin 101, which was recently noticed in this column[1]; and gives valuable information on the subject of milling in general, and on the value of the Fulton specialities in particular. Fulton mills and crushers have been installed with great success in sugar producing countries in different parts of the world, especially in Cuba, where over 50 units are now in operation. Quite recently a 32 in. × 66 in. Fulton double crusher was purchased by the Zululand Milling Co., Ltd., and from it excellent results are expected. In this apparatus pressure is maintained on each top roll journal by a hydraulic ram in the top cap, and the leathers may be quickly replaced without disconnecting the pipes. The main cane carrier will be driven through triple reduction steel gears by heavy twin engines mounted on massive cast-iron columns. The rigid construction and slow operating speed of this drive reduce vibration and wear to a minimum, thereby ensuring long life and noiseless operation. Fulton patented step-down grooving and the permanent rough surface of the rolls have the effect of reducing all feeds gradually and uniformly in size throughout the process of milling. The design of the grooves is such that the crusher rolls split and shred the stalks delivering the crushed cane to the first mill with the pith exposed to the surfaces of the rolls, which permits a close setting of the mill, without risk of slipping. This Bulletin is richly illustrated by photographs and drawings of particular interest; and it (or its English version) should be in the hands of all sugar engineers.

The Kestner Patent Water-Tube Boiler. (Ransomes, Sims & Jefferies, Ltd., Orwell Works, Ipswich.) 1922. Free on application.

Kestner's name is very well known by sugar manufacturers in connexion with his evaporator; but this eminent French engineer has acquired high repute among technologists in a number of different industries by reason of his invention previous to the war of a boiler which has come to be regarded as a standard type. This boiler offers particular advantages where floor space and rapid steam raising, combined with satisfactory operation, are considerations; and has already established a remarkable record both in Europe and America for low cost of maintenance, economy in installation, and exceptionally high efficiency. It is of a comparatively simple type, consisting of two superimposed drums connected by a double row of vertical perfectly straight tubes (about 23 ft. long), the gases from the grate or combustion chamber, or from both, passing through the tubes at right angles, then being deflected from side to side by c. i. baffles, until after 7 or 8 passes they enter the flue in which an economizer is placed. These boilers are constructed to be used in connexion with furnaces burning bagasse. Full information regarding them, and also the type of furnace which is recommended, will be given to those interested by Messrs. Ransomes, Sims & Jefferies, Ltd., of Ipswich, who are the sole licencees and manufacturers for the United Kingdom, British Colonies and Dependencies, South Africa, Dutch East Indies, and China. This firm publish an attractive pamphlet descriptive of the Kestner boiler, for which all concerned in steam production are advised to write.

Testing that pays Dividends. (The Dorr Company, 101, Park Avenue, New York, U.S.A.) 1922. Free on application.

This is an artistic pamphlet giving some information regarding the laboratories and testing plant of the Dorr Company at the Westport Mill, Connecticut, 44 miles from New York City, on the New Haven Road. Here in a beautifully wooded New England valley investigations are conducted on manufacturing processes involving the separation or concentration of precipitates or sediments of every kind by the continuous Dorr methods, which are well known in most industries. Recently we published some particulars of the application of the Dorr "thickener" to the clarification of raw cane juices,[2] it being stated that promising results had been obtained with this apparatus in a factory in Cuba. Developments in this direction will be watched with interest.

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[1] *I.S.J.*, 1921, 640.

[2] *I.S.J.*, 1921, 93.

Brevities.

A nomograph for the calculation of the recovery by Deerr's *sjm* formula has been drawn up by Mr. John J. Riehl,[1] engineer, Hawaiian Philippine Co. Two operations are necessary; and it is said to yield results exceedingly close to those obtained by calculation, but in a fraction of the time.

C. S. Hudson[2] recently described a process based on Duryea's patent[3] for making a syrup having "a pure sweet flavour free from malt" from starchy products (as corn, flour, grit, cassava, etc.), the composition of which averages: maltose 70–76; dextrose, 2–6; dextrin, 1–4; ash, 0·3–0·4; nitrogenous substances, 0·3–0·8; and water 20–22 per cent. It is called "Sugola."

Mr. E. W. Kopke[4] favours continuous settling tanks having conical bottoms, since he has found these more efficient and lower in initial cost than the usual intermittent tanks. He suggests an installation of three, which could be operated either in series or independently, as required. He also recommends that sugar machinery manufacturers should advise the adoption of these tanks, as preferable to the older type.

It is stated by G. C. Calvert[5] that model water-gas plants working at the Metropolitan Laboratories, Twickenham Park, near London, are making ethyl alcohol at the rate of 1 gall. per 1000 cub. ft. of gas produced. He adds that there is every indication that this efficiency will be greatly increased on larger scale plants; that the process is extremely simple; and that it works consistently under all conditions likely to be met with in practice.

A liquid adhesive of great binding power is produced by warming to about 70°C. a mixture of one part of slaked lime, four of sugar, and 12 of water[6] Another method is to heat beet molasses to about 70°C. with so much caustic lime or milk-of-lime that one mol. of sugar corresponds at least to one of CaO, the mixture being poured away from the precipitate which settles out after a time.[7] According to another recipe,[8] an adhesive equal to gum arabic is obtained by evaporating to a suitable consistency a mixture of 20 parts of candy sugar, 7 of cow's milk, and 50 of 26 per cent. water-glass. An adhesive well known in Germany as "Syndetikon" is stated[9] to be made from 10 parts of gum arabic, 30 of sugar, and 100 of water-glass.

In the course of an interesting article on the production of alcohol motor fuel from vegetation, T. A. Boyd[10] points out that at the present time in saccharifying cellulose and fermenting the liquid obtained, a yield of 15–25 gallons of alcohol per ton of dry wood is obtained by the acid process. If a yield of 60–65 gallons could be realized by a process comparing favourably in cost with that now employed, the success of this source of motor fuel would be assured. In another article on the same subject, H. Hibbert[11] mentions that under the action of certain ferments, associated with specific micro-organisms found in horse manure, river mud, etc., the cellulose may be converted to cellobiose and then to fermentable sugars So far this possibility has been realized only in the laboratory, but "patient, intensive, scientific research" may ensure its success on the technical scale.

At one of the meetings of the sugar men's convention held in September last at Bacolod, Negros, P.I., the question of the use of meters for the measurement of maceration was raised.[12] The discussion brought the information: (1) that the venturi meters installed in one of the Hawaiian factories have not proved satisfactory, the range of error being from 3 to 8 per cent.; and (2) that a Columbia recording device in connexion with a weir had given good results at the Hawaiian-Philippine Factory, at Silay, P.I. Recording steam flow meters were unanimously approved, steam economies having been effected wherever this apparatus has been installed. These meters make it possible to determine exactly where the steam is being used, and how much at a given moment. It is thus possible to prevent the steam requirements from rising to an undesirable peak at any one time.

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[1] Published in *Sugar News*, 1921, 2, No. 11, 484.
[2] *American Food Journal*, 1921, 16, No. 4, 11–13. [3] U.S. Patent, 1,110,755–6; *I.S.J.*, 1915, 101.
[4] *Sugar News*, 1921, 2, No. 11, 510.
[5] *Chemical Trade Journal*, 1921, 70, No. 1809, 82.
[6] *Bayer. Ind. u. Gew.-Bl.*, 1872, 242 [7] Austrian Patent, 4127 of 1911. [8] German Patent, 37,074.
[9] See Hager's "Handbuch," page 110.
[10] *J. Ind. Eng. Chem.*, 1921, 12, No. 9, 836–841. [11] *Ibid.*, 1921, 12, No. 9, 841–843.
[12] *Sugar News*, 1921, 2, No. 11, 506–507.

Brevities.

At the Brazilian Centenary Exhibition to be held at Rio de Janeiro in the Autumn, British firms who do not want to take space for exhibits can nevertheless represent their goods by means of illuminated coloured transparencies, set in specially prepared panels. Each panel will be 20 ins. wide providing room for four plates. The inclusive charge for the display of four such photographs during the period of the exhibition will be £30 plus the cost of the plates (about £5 each).

The *South African Sugar Journal* remarks[1] in reference to the articles which we recently published on alcohol-ether motor fuel[2] that "our contemporary spells the name 'Natilite,' and as this seems to be robbing Natal of the honour of having invented the new motor fuel, we mention it in the hope that the error will be rectified." However, we would point out to the *S.A.S.J.* that our spelling is correct, the trade mark registered by the Alcohol Fuel Corporation, Ltd., of London bearing the word "Natilite."

Referring to the articles recently published in our columns on the Crockett sugar refinery,[3] we are informed that although the centrifugals which have been installed were of the Watson Laidlaw type they were not actually made in the shops of Messrs. Watson Laidlaw & Co , Ltd , Glasgow, this firm being engaged on war work at the time. They were constructed by the Cresson-Morris Co., of Philadelphia, U.S.A.; and had special baskets and motors designed by Mr. D. J. LEWIS, a member at that time of the firm of W. J. Wayte, Inc., who represented Messrs. Watson Laidlaw & Co., Ltd., in New York.

A paint[4] for covering the cement plaster walls of sugar factories, less expensive and more durable than oil paint, is said to be made as follows :—6 kg. very fine sifted lime and 1 kg. of salt are mixed with 4 litres of water and heated to boiling. Before the mixture cools, 250 grms. of alum, 100 grms. of ferrous sulphate, 150 grms. of potassium carbonate, and so much fine sifted sand that the mixture can still be applied with a brush, are added. It is said this paint is excellent for masonry walls exposed to vapour; while, moreover, it is unnecessary to prepare the surface to be painted so carefully as when using oil paints.

At the Durban Technical College arrangements are being made[5] to provide courses in Sugar Technology during the off-season, that is, during the months of February, March, and April, a period during which it is generally possible to release young men from the mills in different parts of the country. Supplementary study is to be continued by the students during the periods intervening between their attendance at the College, and a monthly examination paper will be sent to each, this being returned to him after correction by the lecturer. The syllabus appears a thorough one; the fees are moderate; and altogether this appears an excellent scheme, which might receive consideration in other cane sugar producing countries as well.

Highly interesting experiments are being carried out in different parts of the world on the utilization of the gas produced by the decomposition of organic matter by putrefactive bacteria and their enzymes under aërobic conditions. Mr. JOHN D. WATSON, engineer to the Birmingham Drainage Board, has shown[6] that it is practical and economical to drive a suction gas engine from gas derived from sewage sludge. His test engine gave 34 B H.P. at 250 revs. per min., with ordinary town gas having a heating value of 500-550 B.T.U. per cub. ft ; while with the sewage gas 27·5 to 32 B.H.P. were obtained under similar conditions. He estimates that in the dry matter of the sewage available from the city of Birmingham there is available 9000 tons per annum, capable of producing 320 million cub. ft. of gas. Promising results have been obtained also by the Septic Gas Co., at Parramatta, Australia, and by the Massachusetts State Board of Health. The gas consists mainly of methane, with some carbon dioxide and nitrogen, and is said to originate largely from cellulose so that it may possibly be developed from bagasse and similar materials. There are many places in the world where waste vegetable matter can be obtained in great quantities at comparatively small cost, so that these experiments appear of great interest to power producers.

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[1] 1921, 5, No. 9, 799.

[2] *I.S.J.*, 1921, 147, 213, 266, 386,

[3] *I.S.J.*, 1921, 617.

[4] KARL MICKSCH, *Deutsche Zuckerindustrie.* 1921, 46, 465-466.

[5] *South African Sugar Planter*, 1922, 6, 51.

[6] *Engineering*, September 23rd, 1921; also in a paper read before the Institution of Municipal and County Engineers, in the West Midland District, on November 12th, 1921.

Review of Current Technical Literature.[1]

DETERIORATION OF JUICE IN THE SETTLING TANKS. *W. R. McAllep. Paper presented at the 18th Annual Meeting of the Hawaiian Chemists' Association.*

In 1919 Mr. H. S. WALKER[2] carried out some experiments in the factory of the Pioneer Mill Co., T. H., on the rate of deterioration of the juice while standing in the settling tanks under different conditions. In 24 hours he found that the purity of limed and heated juice in well insulated tanks had fallen 3°, the temperature during this period having dropped from 212° to 190° F. He also showed that the loss in purity could be largely diminished when the limed juice was run into the tanks at a temperature of 180° F., the clarified juice being later re-heated; while another point demonstrated by Mr. WALKER was that the addition of formaldehyde had no effect in improving the keeping quality of the juice while standing. The matter has again been taken up by chemists in Hawaii. Mr. V. P. IYER carried out tests at the factory of the Waiakea Mill Co., the results of which were not altogether conclusive, but appeared to show that when the tanks were filled with juice at about 190° F., and when the temperature did not fall below 160° F., the loss in the purity after 12–24 hours was much less (about 0·25°) than under other conditions, viz., when the initial and final temperatures were 212° and 185° F. (loss 2·3°); or 182° and 145° (loss 1°). Mr. A. FRIES made experiments at Makaweli in uncovered tanks, during May and June, in which the juices were heated to 185° F., and the loss in purity after 20–25 hours averaged 0·72° with formalin and 2·76° without this reagent. In September, however, apparently under the same conditions the average loss was the same with and without formalin, viz., 0·24°, seemingly confirming Mr. Walker's experiments. This led Mr. FRIES to say that he thought the differences in the tests to be due to some variation in the nature of the juice. Mr. WALKER agreed that this might be possible, but pointed out that the uncovered tanks would allow the juice to cool below the critical point at which certain bacteria are active. Lastly, Mr. MCALLEP drew attention to a high temperature organism, which closely resembles *B. levaniformans* in form and size (but lacks the property of producing gum); which grows vigorously at 100° to 170° F.; and which is active in moderately alkaline sugar solutions. He believed that some of the results obtained by the chemists mentioned above might be explained by the presence of this organism in the juices. At any rate it is clear that the matter is one requiring further investigation.

EXPERIMENTS ON THE APPLICATION OF DECOLORIZING CARBON ("CARBORAFFIN") CARRIED OUT DURING 1919-21. *Jaroslav Dědek. Listy Cukrovarnické, 1920-21, 39, 383; Zeitsch. Zuckerind. cechoslov. Republik, 1922, 45 (iii), No. 18, 177–183.*

Since 1919 experiments on the application of "Carboraffin" have been carried out in four beet sugar factories in Czecho-Slovakia; and from Dr. Dedek's interesting report on this work the following information is culled. It appears that the manufacturers of the carbon mentioned have been endeavouring to increase its decolorizing power, so that the grade put on the market in 1920-21 had a value about 50 per cent. higher than originally, though some deliveries varied a good deal, due (it is said) to an insufficiently fine grinding. In the experiments, liquors having a density of about 55° Brix (but never over 65°), made from re-melted affined sugars, were used, and were filtered through presses on the frames of which a layer of carbon had previously been deposited. Thick-juice (or syrup from the evaporators) yielded much less satisfactory results, a strikingly rapid decrease of the decolorizing power of the carbon being observed, the cause of which may be explained by the presence in this product of all those colouring substances which later would accumulate in the molasses, as well as by the presence of colourless colloids. It is stated that the amount of "Carboraffin" required varied from 0·07 in the case of well affined crystals to 0·15 per cent. (calculated on the raw sugar). Often it happened that sugars boiled from liquors thus treated possessed a greyish yellow tinge, and this is attributed rather to the irregular functioning of the decolorizing station than to the presence of any fine carbon that might have passed through the filters, it being noticed furthermore that sugars thus tinged contained at the same time traces of invert sugar.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*

[2] *I.S.J.*, 1919, 611–613.

A notable phenomenon was the decrease of the alkalinity of the liquors after treatment with the carbon, proceeding in the case of fresh batches as far as an acid reaction, and resulting in the formation of invert sugar, in browning during boiling, and in the production of a greyish sugar. This decrease of alkalinity was due to two causes; the first being the presence of acid in the carbon (the hydrochloric acid and zinc chloride[1] having been insufficiently leached out during manufacture), and the second being the adsorption of calcium salts. Maintenance of the correct alkalinity is one of the main conditions of the successful application of "Carboraffin"; and it must be met either by treating fresh batches with lime water or by using liquors possessing initially a high alkalinity. Matters must be so arranged that the decolorized liquor running from the presses containing the cakes of carbon[2] has a distinct phenolphthalein alkalinity, say 0·005 to 0·008 per cent., but not much higher, otherwise the decolorizing action of the carbon suffers. Experience has further shown that the liquors used for treatment with the carbon must be perfectly clear and brilliant, for if they are muddy or even slightly dim the amount of material required rises to an extraordinary degree, due of course to the solid particles inactivating its surface Moreover, the rate of filtration suffers. Regarding the temperature, the higher the better (up to 95° C.), and in no case should it be allowed to fall below 60° C., otherwise both the amount of decolorization and the rate of filtration suffer considerably.

DECOLORIZING CONSTITUENT OF ANIMAL CHARCOAL (BONEBLACK). *Claude H. Hall, Jr.* *Journal of Industry and Engineering Chemistry, 1922, 14, No. 1, 18.*

In 1903 the late T. L. PATTERSON, of Greenock,[3] described at some length certain remarkable experiments on the separation from char of a nitrogenous constituent, to which apparently the decolorizing power appears to be due. This work has now been repeated and confirmed by the author. He digested about 15 grms. of char with 90 c.c. of 15 per cent. hydrochloric acid for 20 min., filtered the mixture through an alundum crucible, and dried the residue at about 120°C. Approximately 30 per cent. of the char, chiefly mineral matter, had thus gone into solution. The crucible containing the residue was suspended in a small beaker of concentrated sulphuric acid, and allowed to remain on a water-bath for about two hours, the matter remaining being filtered off through the same crucible, and washed with 80 per cent. sulphuric acid. This acid extract was poured into about half a litre of water, which was set aside for several hours. At the end of that time, a brown precipitate was found to have collected in the bottom of the beaker. This was the active decolorizing constituent of the char, a few drops of its concentrated suspension being equal to several grms. of good boneblack. It may be filtered off through a fine filter; but it is almost impossible to wash this precipitate, since it becomes colloidal as soon as the sulphuric acid is removed. Following this the author precipitated the concentrated suspension on ordinary wood charcoal (which has no appreciable decolorizing power); and thus prepared a material having about twice the activity of the original char (though this is easily explained by the fact that the extract from about 15 grms. of char was suspended on about 6 grms. of wood charcoal). It is concluded that the decolorizing action of boneblack is entirely due to a mixture of nitrogenous decomposition products of bone cartilage, etc., these compounds being insoluble in ethyl alcohol, ether, benzine, and chloroform, but soluble in ammonium hydroxide, concentrated sulphuric acid, and concentrated hydrochloric acid, from the latter two of which reagents they are precipitated by water. They have the empirical formula of $C_{25}H_{20}N_4O_6$; but their real nature and the mechanism of their action remains a mystery.

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[1] "Carboraffin" is believed to be made by the method described in Zelniczek's patent using zinc chloride. See *I.S.J.*, 1916, 488.

[2] See German Patent, 317,449; *I.S J.*, 1921, 113. The layer of carbon in the presses was 25 to 32 mm. thick.

[3] *J. Soc. Chem. Ind.*, 1903, **22**, 608.

A FEW DATA RESPECTING CANE CULTIVATION AND CHEMICAL CONTROL IN PORTO RICO. *J. M. Giles. La. Planter, 1921, 67, No. 21, 331-332.*

Central Mercedita in 1920-21 produced 13,912 tons of sugar from 104,571 tons of cane; and San Vicente 13,900 tons of sugar from 131,834 tons of cane, that is, yields of 13·30 and 10·54 per cent. respectively. Mercedita's yield is the result of careful selection of cane with a view to attaining a high sucrose content, as well as of patient work in the factory to realize the highest possible recovery of sugar from the cane ground. One field of 14·60 acres, planted with a new variety of cane developed in Santa Cruz by Dr. LONGFIELD SMITH, which had about 17 months in which to develop, gave a yield of 8·3 tons of sugar per acre, the product being 903 76 tons of cane giving 120·466 tons of 96° sugar. Regarding the average chemical control data for Mercedita, the only factory figures here given show: sucrose extracted, per cent. sucrose in the cane, 95·13; sucrose retained, per cent sucrose in the juice, 94·35; and sucrose recovered, per cent. sucrose in the cane, 89·78.

EQUIPMENT OF CHEMICAL LABORATORIES. *C. A. Keane, J. C. Philip, and A. Scott. Chemical Trade Journal, 1922, 70, No. 1812, 170-172.*

Details of the present practice and experience of a large number of laboratories in respect of materials employed and methods of construction are recorded by the authors, who were appointed to collect this information by the Council of the Chemical Society. This is a useful report[1] to those contemplating the design or re-construction of a chemical laboratory.

RE-TESTING THE 100° POINT OF THE SACCHARIMETER; (2) PREPARATION OF CHEMICALLY PURE SUCROSE. *Anton Kraisy. Vereinszeitschrift, 1921, 785-797.*

Objections have been urged[2] against the method employed by BATES and JACKSON[3] for the preparation of the sucrose serving for the establishment of the 100° point of the saccharimeter,[4] one of the main objections being the possibility of the formation of invert sugar by micro-organisms during the process of crystallization. Since at the moment the value of the method of BATES and JACKSON is *sub judice*,[5] the author prefers to follow a method in which the sources of error indicated[6] do not appear, though it is possible they may prove to be extremely small. Therefore, he has elaborated a process for the preparation of pure sucrose by precipitation with alcohol, which precludes the danger both of bacterial effect and the hydrolysing action of hydrogen ions. Preliminary experiments assured him that it is really necessary to work with a slight alkalinity, since in the case of neutral solutions there is an appreciable formation of invert sugar during the hours of standing at a comparatively high temperature. Then in another series of experiments, he studied the optimum proportion of sugar, liquor, and alcohol for the precipitation of the sugar, finally arriving at the following procedure:—

1–1½ kg. of sugar are dissolved in sufficient water to form a 70–73 per cent. solution, heating being carried out in a water-bath at 65°C., during 1–1½ hours. The water used must previously be boiled, then rendered slightly alkaline by the addition of sodium hydroxide (80–100 mgrms. per 500 c.c.) so as to impart an alkalinity equal to 0·003 per cent. of lime (CaO), using phenolphthalein. In order to ensure the solution being free from fine grain, it is passed while still hot through a suction-filter (dressed with ordinary filter-paper); and from this point onwards the solution must carefully be guarded from sugar dust or other "seed." Now alcohol (freshly distilled over lime, and as free from water as possible) is added to the almost cold solution in small portions at a time while agitating, the total volume added being about four times that of the water originally used for the solution of the sugar, that is, 1½ times the volume of the sugar solution. A supersaturated alcoholic solution of sugar is thus formed. It is passed through a suction-filter (20 cm. diam., using hardened filter-paper) with the aid of slightly reduced pressure, 1–1½ hours being required in so doing. Half of the filtrate is returned again to the filter. It is convenient to connect the suction-filter with a 2–3 litre separatory funnel by means of an adapter provided with an arm leading to the water-jet vacuum pump, as this arrangement permits of portions of the filtrate being drawn off from time to time without interfering with the mounting of the apparatus. The filtrate is placed in a mortar, and stirred while crystallization proceeds. At the end of 2–3 hours, the crystals are drained on a suction-filter (using hardened filter-paper), and washed with hot alcohol several times. After draining dry, the crystals are spread out on porous plates to dry in the air, and in this way a tolerably dry sugar (containing only 0·03 per cent. of moisture) can be obtained, but previous to polarization the crystals are dried *in vacuo* at 30–50°C. This process of crystallization from alcohol, however, is repeated three times for the preparation of the pure sucrose. It is then found that if the sugar used was the best refined, the reduction (using the delicate neutral cupric carbonate reagent[1]) is only 1·5 to 1·8 mgrms. of copper per 10 grms. This means that it is free from invert sugar, the reduction indicated being due to the sucrose itself. This is well below 0·004 per cent., which amount of invert sugar is hardly of importance in influencing polarimetric measurements.

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[1] Copies may be obtained on application to the Chemical Society, Burlington House, Piccadilly, London, W. 1.

[2] *I.S.J*, 1919, 520. [3] *I S.J.*, 1917, 380. [4] See also *I.S.J.*, 1921, 588.

[5] A report on this method will be published shortly by the Institut für Zucker-Industrie.

[6] *I.S.J.*, 1919, 520.

HYDROSULPHITES. *André Dubosc.* *La Revue des Produits chimiques, 1920, 23, 723–728; 1921, 24, 11–14.*

Contents of these two articles may be summarized as follows: Constitution; properties; preparation; manufacture; and applications.

INFLUENCE OF AMINO-ACIDS ON THE DECOMPOSITION OF "GLUCOSE" BY LIME AND HEAT. *H. I. Waterman and J. W. L. van Ligten.* *Chemisches Weekblad, 1920, 17, No. 44, 559-562; Archief, 1921, 29, No. 5, 153–160*

One of the authors a few years ago[2] pointed out that amino-acids were capable of preventing, or at any rate of hindering, the decomposition by sodium hydroxide of the monoses dextrose and galactose. They now consider the significance of the observation in regard to the clarification of cane juices by treatment with lime and heat.[3] Laboratory experiments with solutions of dextrose, amino-acids, and lime at different temperatures clearly show the inhibiting effect of glycocoll, aspartic and glutamic acids. In one of the tests a solution of dextrose in water showed a polarization of 3·0°S.; a solution containing the same amount of this sugar after heating to 80°C. with 5 c.c. of lime water (0·044 N.) and 5 c.c. of water showed 1·3°; but in the presence of 5 c.c. of 1 per cent. leucin solution the polarization was 2·8°, the conditions of heating and concentration remaining the same in all three cases. Although in cane juices the content of amino-acids is small (and less than in beet juices), yet the amount appears sufficient to have a marked effect in the manner indicated, as the addition of cane molasses to dextrose solutions when heated with lime demonstrated. A solution containing dextrose and also 1 grm.-mol. of asparagin and 0·5 grm.-mol. of $Ca(OH)_2$ after heating shows no decomposition of the sugar, though its reaction to phenolphthalein was strongly alkaline. If in De Haan's carbonatation process (in which the juice is simultaneously treated with lime and carbon dioxide) the alkalinity be held at 250 mgrms. of CaO per litre, an approximate calculation taking into consideration the amino-acid content of the juice shows that the protection of the "glucose" in this method is largely to be ascribed to the presence o the nitrogenous compound. Thus, if 750 mgrms. of asparagin are present per litre to act as a mono-basic acid this amount at 55°C. will remove the effect of 750/132 × 28 = 160 mgrms. of CaO; and if the "alkalinity" during the De Haan carbonatation be held at 250 mgrms., then the amino-acids should prevent the destructive effect of 160/250 × 100

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[1] *I.S.J.*, 1921, 347.

[2] *Versl. Kon. Akad. v. Wetensch.*, Amsterdam, April, June and September, 1817.

[3] See also *I.S.J.*, 1921, 467.

= 64 per cent. of the lime. Though this calculation is not strictly accurate (since the amino-acid has a disturbing effect on the determination of the lime content by titration) yet in conjunction with the laboratory results obtained it is sufficient to show the important effect of amino-acids in this carbonatation method, and also to indicate the importance of this reaction in other methods of clarifying cane juice in which lime is used.

EXAMINATION OF THE SIZE AND REGULARITY OF SUGAR CRYSTALS. *George P. Meade.*[1] *Journal of Industrial and Engineering Chemistry, 1921, 13, No. 8, 712.*

Examination under a small tripod lens (2·5 to 3·0 diameters) and comparison with photographic standards proved fairly reliable in the hands of a trained observer, but the method was tedious and hard on the eyes, and did not admit of ready use by different operators. It occurred to the writer that magnification by projection would fulfil all requirements. The apparatus selected for the purpose is a Bausch & Lomb "Balopticon," Model C[2], with lens of 8 in. focus, a 1⅝ in. diameter projection lens, and a 400 watt incandescent Mazda lamp. The "Balopticon" is fitted with a vertical attachment in order that the object to be projected may be placed in a horizontal position. Experiment has shown that the apparatus magnifies 10 diameters when placed with the centre line of the projection lens exactly 7 ft. from the screen. To cut off the greater portion of the daylight, a black curtain made in the form of a tube or tunnel, about 3 ft. across, is hung on a frame of light iron rods, with the screen at one end of the tube and the projection apparatus at the other. The curtain can be drawn back when the apparatus is not in use, leaving the greater portion of the table which the apparatus occupies free for other work. A small amount of the sugar to be examined is placed in a 40 mm. petri dish, a few c.c. of sugar-saturated alcohol are added, and the crystals are separated by rolling them gently under the finger. The dish is then placed on a metal stage on the horizontal condenser, and the image focused on the screen. A scale of 10 is used for reporting the size, No. 1 being very small, and No. 10 very large. Various methods of comparison were tried, but the following proved the most satisfactory:—The screen is a smooth plaque of plaster of Paris, about 18 in. square and 0·5 in. thick. On the surface of the screen are drawn five squares, 3 5 to 4 in. on a side, subdivided, and arranged so as to be distributed over the circle of light thrown by the projection apparatus. The lowest square is subdivided into 4-mm squares, the next square into 6-mm. squares, the middle square into 8-mm. squares, and the other two into 10-mm. and 12-mm. squares, respectively. No. 5 sugar is about 0·8 mm. on a side, and these sets of squares represent the sizes 3, 4, 5, 6 and 7, allowing for the magnification, and cover practically all of the range of sugars received. The observer compares the projected image of the sugar crystals with the variously sized sets of squares and determines which size the majority of the crystals most closely approximate. This he can easily do to the nearest whole number of the scale, which is the full accuracy required for the purpose of control. The form and regularity of the crystals are also noted, and in case these are abnormal the fact is reported for correction.

DEFINITIONS AND UNITS IN THE CHEMISTRY OF SWEETENING AGENTS (THE DEGREES OF SWEETNESS.) *T. Paul. Chemiker Zeitung, 1921, 45, 705-706;* through *J. Soc. Chem. Ind., 1921, 40, No. 16, 601 A.*

The "degrees of sweetness," DS, of a substance is defined as the number of grms. of pure sucrose, which in a given volume of water has the same sweetening effect as 1 grm. of the substance. The DS of dextrose was found to be 0·52; of levulose, 1·03; lactose, 0·28; of mannitol, 0·42; and that of a starch syrup containing 78 per cent. of solids, 0·26. These values appear to be independent of the concentration, at least for sucrose concentrations between 20 and 100 grms. per litre. For saccharin and dulcin, the DS diminishes with increasing concentration, the values corresponding to sucrose concentrations of 20, 60, and 100 grms. per litre, being 667, 316, and 187 in the case of saccharin, and

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[1] Central Control Laboratory, Cuban-American Sugar Co., Cardenas, Cuba.

[2] *I.S.J.*, 1920, 526, 585, and 654.

364, 90, and 70 respectively in the case of dulcin. The DS of a mixture of saccharin and dulcin is greater than that calculated from the values for the separate ingredients; *e.g.*, 280 mgrms. of saccharin and 120 mgrms. of dulcin in a litre of water have the same sweetness as 535 mgrms. of saccharin alone in the same volume. The "sweetening unit," SU, of a substance is defined as the number of grms. required to produce the same effect as 1 kilo. of sucrose in a given volume of water.

THE RARE SUGARS: THEIR PURITY AND TESTING (1) *Carl Pfanstiehl and Robert S. Black.*[1] *Journal of Industrial and Engineering Chemistry, 1921, 13, No. 8, 685-687.* (2) *Howard T. Graber. Ibid., 1921, 13, No. 8, 687-688.*

Specifications for pure sugars, especially for those used in bacteriological work, are given, and also some details of analytical procedure.

COST OF MANUFACTURE OF ALCOHOL FROM SULPHITE LIQUOR. *N. Clementsen. Pulp and Paper Magazine of Canada, March 24th, 1921.*

According to figures furnished by the Ethyl Alcohol Co., of Sweden, the cost, including fuel, labour, power and light, plant depreciation and interest, works out at 21·4 cents per gallon. No charge is made for the raw material, this being a waste product. Gosta Ekstrom's patents are operated; and it is said that the fermented wash is evaporated in a Thunholm evaporator for use as fuel. It is estimated that a fuel valued at 11,700 B.T.U. can be produced at $5·13 per ton.

ALCOHOL-ETHER MOTOR FUELS. *J. P. Foster. Sugar News, 1921, 2, No. 11, 521-526.*

This is a review of the subject of motor fuels, from which a few remarks may be excerpted. Alcohol is the one material which can successfully meet all the conditions for the manufacture of a satisfactory gasoline substitute. From it ether can be made, the combination of which with alcohol gives ease of starting, speed, flexibility, and a higher thermal value than when alcohol alone is used. However, more than a certain proportion of ether cannot be used in admixture with the alcohol, since then the temperature of the intake manifold will fall below the dew-point, resulting in the condensation of the fuel with consequent loss. It is said that in the case of a mixture of alcohol and ether a series of complex conversions constantly occurs, resulting in the formation of corrosive compounds, the extent depending upon the water content of the alcohol, and upon the surface exposed to the atmosphere. Eventually acetic acid is formed, which attacks the supply containers and the engine tanks. "It is obvious[2] that the production of a successful synthetic fuel for internal combustion engines involves not only the problem of protecting the engine from the products of combustion, but the far more involved and important problem of protecting the fuel itself from destructive action and the fuel storage and supply system from the deleterious effects resulting from such auto-destructive action of the fuel." This action is stopped or at any rate retarded by the use of a base converting the acids into neutral salts. It must be soluble in alcohol and ether, and must be non-volatile (the use of ammonium salts thus being excluded). Primary, secondary or tertiary amines have been found by the author to be the most suitable basic chemicals; but while the amines are a very large group there are only two which are neither costly nor scarce. These two are aniline (phenylamine) and pyridine, the latter of which has met with approval as a denaturant also.[3]

A DRY-ROT CANKER OF SUGAR BEETS. *B. L. Richards. Journal of Agricultural Research, 1921, 22, No. 1, 47-52.* (Seven plates.)

J. P. O.

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[1] See also *I.S.J.*, 1921, 466.

[2] This is an extract from U.S Patent 1,384,946, taken out by J. P. FOSTER.

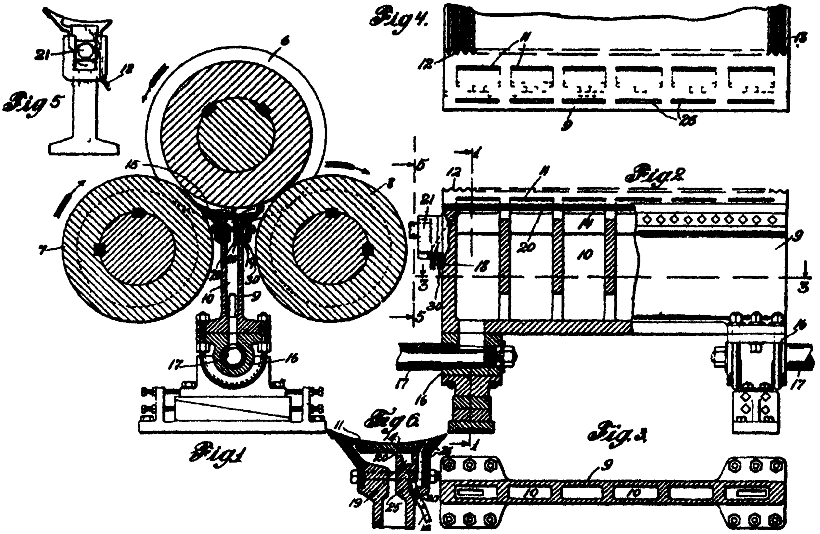
[3] In the author's patent (No. 1,384,946) aniline only is claimed for as the substance to be added for inhibiting the formation of the acid substances alleged.

Review of Recent Patents.[1]

UNITED STATES.

HOLLOW TRASH TURNER OR TURNING PLATE FOR MILLS. *Godfrey Engel, Sr.*, of Brooklyn, New York. *1,386,999.* August 9th, 1921. (Six figures)

The mill illustrated is of typical construction embodying the top roll *6*, co-operating with a feed roll *7* and a discharge roll *8* ; while *9* designates the turning plate or beam, the same being shown as of hollow construction to provide a collecting chamber or pocket *10* therein *11* indicates the inlet slot provided in the curved top of the plate adjacent the forward edge thereof and relatively close to the feed roll. This inlet slot may be continuous or interrupted as indicated in Fig 4 The forward edge of the turning plate is shown as toothed at *12* to match the corresponding corrugations *13* in the feed roll.



In making up the turning plate, it is best to construct the plate or beam as a hollow casting open at the top, and to provide a detachable cover plate *14* for closing said open top, a detachable lip *15* of hardened steel, for instance, constituting the toothed forward edge of the plate The cover plate and lip may, if desired, be made in one piece. The juice which flows through the inlet slot or slots *11* is collected in the chamber in the turning plate and is led off therefrom by a suitable outlet or outlets, two of such outlets being shown in the form of tubular hubs *16* from which discharge pipes *17* are led to the collection tank or tanks These tubular hubs thus provide bearings on which the turning plate may be rotatably adjusted to bring it into proper mesh with the rolls. To prevent the inlet from becoming obstructed with the bagasse, a connexion *18* is provided for supplying steam or air or other fluids under pressure to the chamber *19* located in the upper part of the turning plate in rear of the inlets and connected with the inlets through a passage, *20* (Fig. 1), positioned well above the juice outlet to prevent blowing out the juice. When it is desired to blow the inlets clear and effect sterilization, the drainage outlets or outlet are usually closed and the steam or air under pressure is admitted through the connexion *18*. In order that the collected juice may be quickly disposed of, the outlets *17* may be connected with a suitable suction pump with provision of an automatic valve mechanism by which the flow to the pump will be automatically cut off when the pressure is admitted through the pressure connexion described. The admission of the cleansing or treating fluid may be controlled by means of a suitable valve such as indicated at *21*, located at one end of the turning-plate. The fermentation preventive, which may be milk-of-lime for instance, may be introduced, as indicated in Fig. 6, by means of a supply connexion *30* into a channel *25* having communicating passages *26* extending up through the top of the turning-plate in the rear of the juice extraction slots *11* and disposed so as not to interfere with the cleansing effect of the compressed air, gas, or other fluid that may be used. As is well known, fermentation frequently starts as soon as the juice is extracted from the cane; but the construction just described enables one to forestall and overcome any tendency toward fermentation. This invention makes it possible to collect the juice immediately after it is expressed by the first pair of rolls and to thus prevent said juice being re-absorbed by the expanding cane as it passes on to the second pair of rolls. This fact enables one to materially reduce the number of rolls necessary since the cane, after passing over the turning-plate, contains but a comparatively small amount of juice.

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[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2fr. 00 each).

ENHANCING THE GROWTH OF PLANTS BY THE APPLICATION OF MULCHES.[1] ***Charles F. Eckart***, of Honolulu, T.H. (1) *1,377,566*. May 10th, 1921. (2) *1,396,269*. November 8th, 1921.

After the water and the fertilizer have been added to the soil, the proposed lines of the rows have a suitable mulch or covering applied thereto in surface contact with the ground. This mulch is made preferably of a paper or fabric impregnated, coated or otherwise treated with tar, asphalt, creosote, oil, wax, paraffin, paint, or a mixture of two or more of these substances, so that it is rendered substantially water-proof and opaque, and possesses, in a large degree, the capacity to absorb solar heat and distribute the stored heat, by radiation and convection, into the subjacent soil. This mulch having been applied, if necessary a sufficient period is allowed to elapse to ensure the growth and the subsequent destruction of the weeds, or at least those which would otherwise require to be eradicated by conventional cultural methods.

Openings are then made in the mulches at the planting centres by slitting the covering to form flaps and by bending back these flaps. Plant seeds, bulbs, or other stock are set in the planting area, the body of the mulch remaining in place, so that the plants which develop will grow unhampered by weeds and undisturbed by cultivating. As the flaps may lie almost prone or be bent into various positions they will permit the controlling of the growth of the plants to a nicety, in that the evaporation of the moisture from the planting areas may be controlled, as may also the access of the wind, while the temperature of the planting area is maintained at a more or less even degree.

CANE PLANTING MACHINE. ***Henry M. Remy***, of Constancia, Cuba. *1,377,929*. May 10th, 1921. (Thirteen figures.)

Broadly stated, the machine comprises a wheel mounted supporting frame carrying at its forward end a furrow forming member, fertilizer distributing means positioned to deposit fertilizer in the furrow formed immediately subsequent to forming thereof, cane depositing means for depositing lengths of seed cane in the furrow after fertilizing thereof, and covering discs positioned at the rearward end of the machine for covering the cane thus deposited.

RECOVERY OF POTASSIUM SALTS FROM MOLASSES DISTILLERY SLOPS OR SPENT WASH. ***Milton C. Whitaker*** (assignor to ***U.S. Industrial Alcohol Co.***). *1,400,192*. December 13th, 1921.

Distillery spent wash is sprayed into contact with vapours containing silicon tetrafluoride.

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[1] See also, *I.S.J.*, 1917, 455; 1918, 434, 567; 1919, 626.

CANE HARVESTING MACHINE. *Rudolph A. Mayer*, of Pecan Island, Louisiana, U.S.A. *1,392,258*. September 27th, 1921. (Twenty-five figures.)

Claim 25 is as follows: In a machine of the class described, a frame structure including spaced side members, each having a superstructure, conveying means including driven chains carried by the respective superstructures, said chains having co-acting inner stretches for carrying stalks upwardly and rearwardly between the frame members and their superstructures, an obliquely disposed driven reel inclined upwardly and rearwardly with respect to the conveying means, cutting means co-acting with the reel and deflecting means adjacent to the downgoing side of the reel to hold the stalks from engagement with the reel for a given period according to the respective length of the stalks; in combination with a driven auxiliary conveyor chain supported above the reel in an oblique position with respect to the frame structure, said auxiliary conveyor chain having prongs that project beyond the deflecting means adjacent to the reel.

MOTOR FUEL CONTAINING ALCOHOL AND ETHER. *Walter T. Schreiber* (assignor to *U.S. Industrial Alcohol Co.*, New York). (1) *1,398,947*; (2) *1,398,948*. November 29th, 1921,

(1) A fuel comprising: 30-35 per cent. of ethyl alcohol; 25-35 per cent. of benzol; and from 20-40 per cent. of ethyl ether. (2) A fuel consisting of: 90-92 parts by volume of a petroleum distillate having a density between 30 and 50° Bé. and about 8 to 10 parts of "a very volatile combustible constituent."

MACHINES FOR MAKING SPIRAL STICK CANDY. *Fred E. Zaiss*, of Chicago, Ill., U.S.A. (1) *1,400,127*; (2) *1,400,128*. December 13th, 1921.

CLARIFICATION (SULPHITATION) OF BEET JUICES. *M. von Wierusz-Kowalski*, of Leipzig, Germany (assignor to *The Chemical Foundation, Inc.*, of Delaware, U.S.A.). *1,399,533*. December 6th, 1921.

Claim 1.—The process of treating raw juices which comprises admitting sulphur dioxide to the juice while cold until an acid reaction is obtained, neutralizing with a solution of calcium hydroxide, adding milk-of-lime to the unfiltered juice, until a decided alkaline reaction is obtained, heating, filtering, adding lime to the filtrate thus obtained while hot, again filtering, and then working the filtrate up into massecuite.

HARVESTER AND LOADER FOR BEETS. *William Z. Pulliam*, of Los Angeles, Cal., U.S.A. *1,399,876*. December 13th, 1921.

REFINING CHOCOLATE. *William C. Schöpper*, of Astoria, New York, U.S.A. *1,390,251*. September 6th, 1921.

ROTARY CANE CUTTING KNIVES.[1] *Alfred M. Simpson*, o Honolulu, T. H., U S.A. *1,396,600*. November 8th, 1921. (Three figures; nine claims.)

Referring to the drawings, *1* indicates a shaft, which is preferably cylindrical in form and is provided with a series of longitudinal keyways *2*, spaced at regular intervals about the periphery thereof and serving as part of the primary means for locking the individual knives to the shaft. In the particular embodiment of the invention illustrated, four of said keyways are shown spaced 90° apart. Each of the knives comprises a hub section *3*, which is relatively thick, terminating in two oppositely disposed radial blades *6, 6*, which are provided at their junctions with the hub portion with filleted shoulders *5, 5*, the blades *6* having cutting portions *6'* preferably welded thereto and formed of a superior grade of cutting steel, the main body portion of each cutter being formed as an integral casting, which, because of the relatively thick hub portion and the filleted shoulders between the hub and the blades, is exceptionally strong and is effective in resisting the tendency of cutters of this character to rupture at the points of juncture between the blades and the hub. The hub *3* is provided with a central shaft-engaging opening *4*, the major portion of which hugs the shaft, said opening *4* being extended laterally of one side of the hub, as an open throat to permit the cutter to be passed over the shaft. Formed in the body of the hub at each side of the open throat is a shoulder *7*, provided with a generally rectangular recess *8* in the bottom thereof. Each of the shoulders *7* is also provided with a tapped bolt hole *9*, which preferably registers centrally with the corresponding recess *8*. The throat or lateral opening in the hub *3* is closed by a cap *10*, the inner surface of which conforms with that of the shaft *1*, which it closely engages when in position, and is provided with lateral wings *11*. These engage the shoulders *7* in the hub, each of said wings being provided with a rib or boss *12*; which fits in the recess *8* in the corresponding shoulder *7*. The arcuate shaft-engaging surface of the cap is provided with a keyway *17*, adapted to receive a key *15*, which is substantially rectangular in cross section and extends beyond the face of the cap to engage one of the keyways *2* in the shaft *1*. The key *15* is provided with a central transverse opening to receive a bolt *16*, by means of which the key is securely locked to the cap. It will be particularly noted that the key *15* is of a length slightly greater than the thickness of the hub *3*, so that the ends of the key project slightly beyond the lateral faces of the hub. The cap is secured to the hub by any suitable means, but preferably by threaded bolts which are passed through bolt openings in the wings *11* and screwed into the bolt openings *9* in the body of the hub. The outer end of each of the bolts *13* is provided with a double lock nut *14*, by means of which the caps are drawn into close interlocking engagement with the hub, as shown.

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[1] A short general description of this apparatus has already been given. See *I.S.J.*, 1922, 85.

Fig. 1

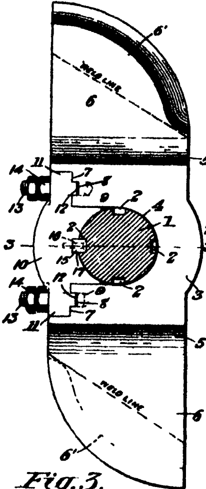


Fig. 2

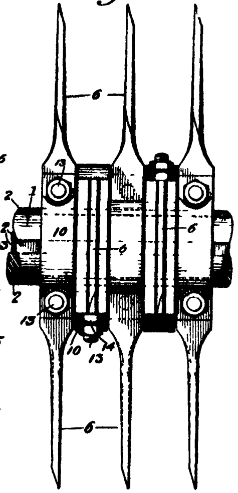
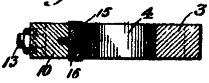


Fig. 3.



In assembling the rotary cutter, the several knives are mounted on the shaft with the radial blades of alternate knives at right angles to each other, which is effected by sliding the knives laterally over the shaft and then applying each cap *10* to its hub, so that the key *15* carried by each cap will engage the appropriate keyway *2* in the shaft. The provision of four keyways *2* in the shaft enables the knives to be so disposed that the key connexions between the successive knives of the series will be spaced 90° apart around the shaft, thereby distributing the torsional stresses evenly about the shaft, and reducing the tendency of the knives to rupture or twist off, which is a common fault in devices of this character when a single keyway in the shaft is provided for connecting all the knives thereto. It will also be noted that the interlock between the wings *11* of the cap and the shouldered recesses *7* in the hub, and also between the ribs *12* on the wings *11* and the recesses *8* in the shoulders *7* of the hub, materially strengthen the structure and prevents any opening or distortion of the throat of the hub due to the heavy stresses imposed upon the cutters when in operation. When the caps *10* have been set firmly in position by means of the lock nuts *14* engaging the threaded bolts *13*, the concave faces of the caps afford an additional clamping means for securing the cutter to the shaft and materially lessening the shearing stresses on the keys *15*.

UNITED KINGDOM.

PREPARATION OF A COCOA SUBSTITUTE FROM BEET, GLUCOSE, CANE SUGAR, OR MOLASSES. *L. G. Leffer,* of Kapellen, Kreis Grevenbroich, Germany. *172,788* (*28,126*). October 4th, 1920.

A substitute for cocoa is prepared from an aqueous extract of roasted substances containing sugar or other carbohydrates, such as sugar beet, turnips, chicory, cane sugar, molasses, or grape sugar, and roasted and ground potatoes, the whole being flavoured with vanillin. The carbohydrate-containing substances are roasted at a temperature that will produce caramel and a bitter principle without excessive degradation of the sugar, 150°C. being suitable for beetroot. They are then extracted with water and the extract mixed with potatoes that have been treated with sulphurous acid, roasted at a temperature not above 130°C., and ground. The mixture is then evaporated to dryness and the residue flavoured with vanillin and ground. Carbohydrate-containing substances having an earthy taste, such as turnips or sugar beet, are treated before roasting with an electrolysed solution of common salt.

GROOVES OF MILL ROLLERS *R. L. Goold* (communicated by the *Fulton Iron Works Co.,* 1259, Delaware Avenue, St. Louis, Miss., U.S.A.). *172,552* (*4242*). February 5th, 1921.

In cane-crushing apparatus in which each of the rolls have circumferential ribs separated by grooves, the pitch of the ribs on the lower roll is greater than that of the other roll, so as to produce relatively wide channels or grooves for conducting the juice away from the rolls. As shown in Fig. 1 applied to a 3-roll mill, the top roll *D* and the delivery roll *C* have the usual large number of small circumferential V-shaped ribs *1* and grooves *2*, while the feed-roll *B* has relatively large V-shaped ribs *3* and grooves *4* forming large canals for the juice. Fig. 3 shows the large ribs *3* disposed opposite to and extending into alternate grooves *2* in the top roll *D*, which has intervening grooves opposite to, and in alignment with, the centres of the wider grooves *4*. Two ribs *1* of the top roll extend into each wide groove *4*, and the inclined faces of the small ribs *1* are preferably parallel to the flaring side walls of the groove *4*. The trash-knife *5* (Fig. 1) has large V-shaped teeth *6* extending into the grooves *4*.

FIG 3

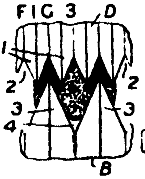
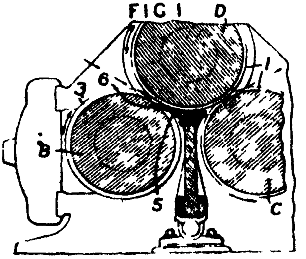


FIG 1



DECOLORIZING SUGAR JUICES, SYRUPS, ETC., BY THE USE OF AN ADSORBING AND REDUCING AGENT IN CONJUNCTION. *J. F. Strautman,* of Enschedé, Holland. *172,272* (*5656*). February 18th, 1921.

Sugar solutions and other liquids are decolorized by the use of an adsorbent and a reducing agent in conjunction. The reducing agent may be applied first, or some adsorbent may be applied first, and filtered off, and the reducing agent may be applied, followed by more adsorbent, or the adsorbent may be allowed to remain in contact with the material while the reducing agent is applied. Examples are given of the treatment of sugar solutions with bone charcoal and sodium hydrosulphite. Sulphur dioxide may also be employed.

BEET HARVESTER. *American Beet Harvester Co.,* of Toledo, Ohio, U.S.A. (assignees of *W. H. Kopitke*). *171,709* (*31,094*). November 21st, 1921; convention date, November 20th, 1920.

A beet harvester is provided with a tread frame which engages the tops of the beets and adjusts cutters to cut off the desired amount of top.

Self-Opening Receptacles for Jam, Condiments, etc. *C. E. France*, of Meersbrook, Sheffield. *164,652 (26,618)*. September 17th, 1920.

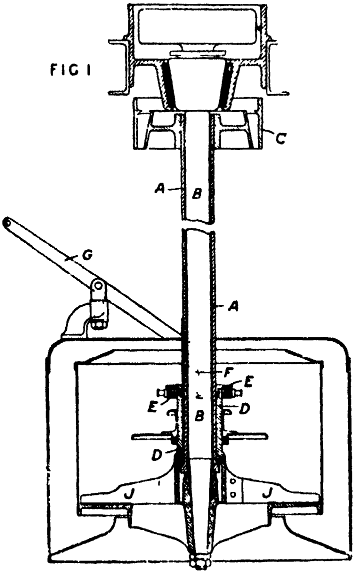
Production of Butyl Alcohol and Acetone. *C. Weizmann and H. M. Spiers*, of Kensington, London, W. *164,762 (9133)*. June 3rd, 1918.

The starchy material contained in horse chestnuts is fermented by the methods described in specifications 4845 of 15 and 164,023 to produce acetone and butyl alcohol. The nuts are dried, husked, and ground to meal, which is treated with cold water to separate saponines, and is then cooked and fermented. The starch, separated by filtration from the wash water and the coagulated material separated by boiling the wash water may be added to the meal.

Centrifugal Machine with a Plough. *A. R. Robertson and A. F. Dunsmore*, of Dundas Street South, Glasgow, Scotland. *172,862* (*34,669*). Dec. 8th, 1920.

A centrifugal machine for drying or treating sugar or other granular material has a plough *J* normally rotating with the basket but provided with means for raising and lowering it along the vertical wall of the basket. The sleeve *A* on the machine spindle *B* carries the brake drum *C*, Fig. 1, and has another sleeve *D* keyed to it at its lower end. The sleeve *D* carries the plough *J*, and a hand-lever *G* is connected by links *F* to the non-rotary side of a muff *E* at the top of the sleeve *D*. For the discharge of the basket, the power is shut off and the lever *G* is operated to cause the plough *J* to travel upwards, the friction producing a slower rotation of the plough than the basket. The muff *E* may be connected by chains over pulleys to counter-weights. In a modification, a sleeve with an internal screw-thread and an operating hand-wheel is used to raise the plough. In a modification for under-driven machines, the basket is mounted on a sleeve with a brake drum. On the upper end of the sleeve carrying the plough is journaled a flange, and any convenient means is used to raise the flange to cause axial movement of the plough. (Specification 8306 of 1914 is referred to.)

FIG I



Packing Sugar in the Form of Plates, Rods, or Cubes. *Soc. Anon. Raffinerie Tirlemontoise*, Tirlemont, Belgium. *173,202* (*11,861*). April 25th, 1921; convention date, December 22nd, 1920.

Relates to a process and apparatus for packing sugar or similar material in the form of plates, rods, or cubes, the material being pushed in layers, into a container open above and below and having elastic walls, from which they are fed into boxes, etc.

Manure containing Peat. *Molassine Co., Ltd., and H. C. S. de Whalley*. *173,276* (*24,933*). August 28th, 1920.

A manure consists of finely-divided peat or peat moss and an ammonium salt, such as ammonium sulphate, in such proportions that the ammonia given off when the product is applied to the soil is sufficient to neutralize the free acids in the peat or to render the peat slightly alkaline. Calcium carbonate may be added to the manure when the soil is deficient in this substance, and any other artificial or natural manures may be added. Specifications 14,487 of 1915[1] and 152,779[2] are referred to.

HOLLAND.

FURNACE FOR THE COMBUSTION OF MOLASSES.[3] *Jan F. W. van Vloten, George E. G. von Stietz, and Jan H. Marsman,* all of Sempalwadak, Java. *6217.* July 3rd, 1921.

Above the body *1* of the furnace is a brickwork tank *2* in which the molasses is heated. In the arched bottom *3* of the tank, made of fireproof material, there is an opening which can be closed by means of a plug *4*, making it possible to regulate the flow of the molasses. In the second opening *5* is placed an iron chimney *6*, provided with a damper *7*, which enables one to conduct more or less of the gases of combustion through this chimney, and thus heat the molasses until it boils (but not so much that it decomposes). A short distance under this tank, the combustion gases are led away sideways through the horizontal brickwork flue pipe *8*. In starting up the furnace, it is heated by means of a wood fire; and as soon as the degree at which the molasses is carbonized is reached, one opens the plug *4* in the bottom of the tank *2*, allowing the molasses to flow into the furnace. In the body of the furnace *1* are a number of grates (three being shown in the drawings) formed of furnace bars *9* made of fireproof material. The bars of the successive grates are so spaced that above each a space *10* is found in the grate above it; while the opening *4* in the bottom of the molasses reservoir is placed perpendicularly above one of the grate bars of the uppermost grate. Thus, the fall of the molasses is interrupted, the originally thick stream splitting into thinner ones, and then into drops, spreading in all directions and falling down below. By this interruption of the fall of the molasses, it is finely divided, this division being facilitated by the great heat of the grates. The molasses fall down yet further, meeting the bars below, which again interrupt its fall, until finally all the water is evaporated and the dry and hot molasses is gasified. The gases evolved are very combustible, and maintain the high temperature of the oven. There remains a mass of charcoal, which collects on the lowest grate *11*, where it can be removed from the furnace, or else allowed to burn further to ash. As is shown in the drawings, a little above each grate there are small doors *12*, *12*, for the control of the operation and the cleaning of the furnace from time to time.

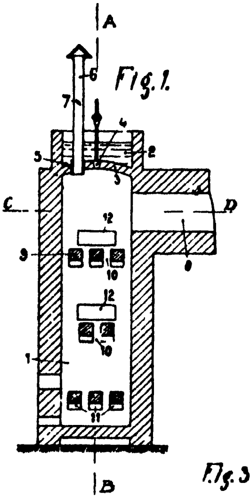


Fig. 1.

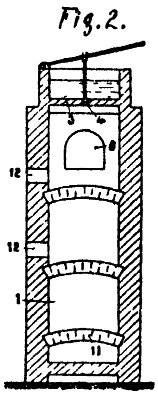
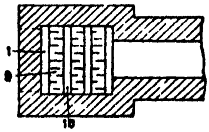


Fig. 2.

Fig. 3



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[1] *I.S.J.*, 1917, 238. [2] *I.S.J.*, 1921, 179.

[3] See *I.S.J.*, 1920, 467, where, in an article by Mr. VON STIETZ, it was stated "it is not possible to burn molasses like other fuels, because it gasifies with difficulty. . . . A special oven has, however, been invented in which it is possible so to regulate the combustion that coke or only ash is obtained. The ash obtained on completely burning such coke can be treated for the recovery of the potash, and some experiments have been carried out in this direction. . . . ."

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1922. Tons.		1921. Tons.
Total Receipts January 1st to February 23rd ..	569,267	..	254,212
Deliveries ,, ,, ,, ..	566,369	..	256,118
Meltings by Refiners ,, ,, ,, ..	472,188	..	234,946
Exports of Refined ,, ,, ,, ..	60,000	..	7,000
Importers' Stocks, February 23rd	2,898	.	9,146
Total Stocks, February 23rd	127,709	..	76,927
	1921.		1920.
Total Consumption for twelve months	4,107.328	..	4,084,672

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1919-1920, 1920-1921, AND 1921-1922.

(Tons of 2,240 lbs.)	1919-20. Tons.		1920-21 Tons		1921-22. Tons.
Exports	405,394	..	67,210	..	70,932
Stocks	264,700	..	182,128	..	116,785
	670,094		249,338		187,717
Local Consumption	8,500	..	10,000	..	5,000
Receipts at Ports to 31st January..	678,594		259,338		192,717

Havana, January 31st, 1922

J. GUMA.—L. MEJER.

Beet Crops of Europe.

(Willett & Gray's Estimates to February 16th, 1922.)

	Harvesting Period.	1921-22. Tons.	1920-21. Tons.	1919-20. Tons.
Germany	Sept.-Jan...	1,330,000	1,152,960	739,548
Czecho-Slovakia	Sept.-Jan...	650,000	705,919	493,781
Hungary and Austria	Sept.-Jan...	68,000	47,000	12,151
France	Sept.-Jan...	285,000	305,041	154,444
Belgium	Sept.-Jan...	300,000	242,589	146,918
Holland	Sept.-Jan...	335,000	316,402	238,692
Russia (Ukraine, Poland, etc.)............	Sept.-Jan...	100,000	89,071	78,013
Poland	Sept.-Jan...	225,000	189,834	140,000
Sweden	Sept.-Jan...	227,000	164,194	145,072
Denmark	Sept.-Jan...	145,000	134,835	152,852
Italy	Sept.-Jan...	200,000	135,484	182,843
Spain...	Sept.-Jan...	135,000	170,722	81,650
Switzerland	Sept.-Jan...	5,500	3,710	8,550
Bulgaria	Sept.-Jan...	22,000	7,837	10,974
Rumania	Sept.-Jan...	25,000	5,000	....
		4,052,500	3,670,598	2,585,488

Sugar Market Report.

Our last report was dated 8th February, 1922.

The home markets have exhibited no special feature during the past month; a steady and regular demand for grocery kinds continues, which is being filled by British Refiners, and arrivals of American and Canadian Granulated. Beyond small quantities of Dutch Granulated at full prices, Continental sugars are not offered. Traders are still nervous of accumulating stocks and remain unimpressed by the evident absence of pressure of Refined. Although manufacturing sugars are in small supply, the demand is poor and values show little change from a month ago. Mauritius Crystals are offered at 43s. 9d. to 44s. per cwt. spot, duty paid. W.I. Crystallised steady slow at 39s. to 42s. 9d., according to quality. Tate's London Granulated is now quoted at 47s duty-paid for prompt and forward; No. 1 Cubes 51s. 6d. American Granulated in first hands is held for 19s. 6d. c.i.f. U.K. March/April shipment, but second-hand lots are changing hands to-day at 19s. 1½d. March, 19s. 3d. April.

The requirements of the U.K., in the shape of imported Refined, may be roughly estimated at 40,000 tons per month, assuming that out of a consumption of 1,450,000 tons our Refiners will perhaps supply 900,000 tons, and allowing say 75,000 tons for W.I., etc., sugars going into direct consumption. Apparently the country must look for these imports to be supplied mainly by American Granulated, and as U.S. Refiners are working at their full capacity, it is understandable that offers are not being pressed from that quarter.

In the White Sugar Terminal Market movements have mostly been influenced by day to day American advices, and August after sagging to the neighbourhood of 18s. has gradually hardened to 19s. 3d. paid and Buyers.

Raw sugars have been actively bought during the past few weeks, and the market is undoubtedly firm under the influence of the general demand from American and U.K. Refiners, Canada, France, Spain and the East Heavy sales of both old and new crop Cubans have been made, recent business including 200,000 bags to American Refiners at 2¼ cents c. & f. New York, two cargoes to U K. at 12s. 6d. c.i.f. and a cargo to France at 12s. 4½d. c.i.f. The Cuban crop is being worked at full swing with 175 Centrals grinding, against 187 at this time last year. Total receipts to March 4th are given as 838,465 tons against 982,190 tons; Receipts for the week 173,168 tons and stock 847,341 tons against 171,585 and 647,321 tons respectively last year. Exports of old crop sugar during the five weeks ended 4th March were 431,569 tons and the stock of old crop at that date was 355,507 tons.

Indian markets are very dull, business being restricted by local strikes and political uncertainties. Stocks, however, are diminishing and an active revival is anticipated on any sign of conditions becoming more settled. The budget, recently published, enacts that the Import Tariff on sugar shall be raised from 15 per cent. to 25 per cent., *ad valorem*, based on the average price of the past year. Naturally this will have the effect of reducing consumption, but imports are still expected to exceed those of last year.

In Java, old crop deliveries after being sold up to 18⅞ guilders, are now easier with sellers of March at 15½ guilders. The February exports are variously estimated at from 23,000 to 34,000 tons. Japan has been a buyer of raws, and 5,000 tons 96's are reported done this week at 9·75 guilders first cost. In new crop, business has been done at 18s. 3d. to 18s. 7½d. c. & f. Calcutta for June/July shipment; to-day's quotations are 18s. 7½d. June/July, 18s. 4½d. July/September.

Czecho-Slovakia is practically out of the market so far as the U.K. is concerned, by reason of the fact that relatively better prices are obtainable from other countries. Sales to France, Roumania, Jugo-Slavia, Norway, etc., have so curtailed the quantity available for export that, according to figures recently published, only 25,000 tons remain unsold; this reckoning the estimated production at 570,000 tons and allowing for 250,000 tons (Refined) for Home consumption and 60,000 tons for the requirements of Austria. From Germany it is reported that although no definite arrangements have been come to regarding sowings, it is not likely that the cultivated area will be larger than last year. French opinion leans to an increase in sowings of 30 per cent.

H. H. Hancock & Co.

10 & 11, Mincing Lane,
London, E.C. 3,
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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

A Reprieve for Kelham.

None too early for saving the situation this year in the matter of Spring sowings, the Government has at length come to a decision to help the English beet sugar experiments out of their present difficulty by adopting the expedient (strongly pressed on them by the various interested parties) of suspending the Excise duty on sugar produced within the United Kingdom. This really amounts to a bounty of some £24 per ton, and is only justifiable from the Treasury point of view in that the home-grown output of sugar is, and will be for a number of years, "such a little one." The total output, indeed, of the two factories, Cantley and Kelham, is considerably less than 20,000 tons per annum and is, roughly, hardly more than 1 per cent. of the total consumption of this country in normal times. The loss to the Excise can therefore be ignored.

But the gain to the experiment of producing sugar within our own country is immeasurably great. We have had occasion to question the wisdom of the arrangements and the finance that has brought Kelham into its present *empasse*, and some of our contemporaries have criticized the venture in unminced fashion. That this factory is grossly overcapitalized, and that, in the opinion of many well qualified to judge, it has been an unnecessarily expensive erection, there seems no doubt. But, after all, it was conceived with the desirable object of proving that beet sugar could be produced in this country to the satisfaction of both the grower and the manufacturer (not to mention the ultimate benefit to the consumer); and it would have been a thousand pities if the experiment had been brought to an abrupt termination at this inconclusive stage just because it was conceived at a most abnormally expensive period of post-war industry.. We are therefore glad that the Government have decided to give the venture a further lease of life.

The decision was announced in the House of Commons, where it provoked cheers; the Minister of Agriculture stated that "the Government had decided that in view of the exceptional circumstances of the new industry of sugar beet, and the condition of unemployment in this country, no Excise duty should be charged on home-grown sugar. The necessary provision for the removal of the existing duty would be made in the Finance Bill of this Session. It was, of course, impossible to bind any future Government [Labour cheers], but in view of the fact that the remission of Excise was intended to assist a new industry during the experimental period, it might be hoped that Parliament would not reimpose any Excise duty until the industry had been firmly established."

As to what constitutes the firm establishment of the industry in this country opinions must differ, but it has been laid down as a suggested axiom that 50,000 tons would be some safe criterion, and that till the output in this country averages that quantity the preference should be continued. The immediate result of the Government's concession is that negotiations with the Kelham farmers for this year's sowings will be facilitated, and it is hoped that a sufficient response will be made and a successful campaign assured. Needless to add Cantley, which was in any event planning a campaign, will benefit equally by the suspension of the Excise, and should also do well. But the reprieve really comes too late to take full advantage of this year, and we must await the 1923-24 campaign for any appreciable increase in production.

The Plight of the British Sugar Colonies.

There is no doubt that the low price to which sugar has fallen since the crisis in 1920 has hit the British sugar colonies severely and while the reports of their impending ruin if they are not aided may be somewhat discounted as *ex parte* statements made with an eye to getting the most they can for the industry, there is no doubt their condition is serious enough to warrant some careful consideration on the part of the home Government. Mr. EDWARD WOOD, the Under-Secretary of State for the Colonies, who has just returned from a tour of the British West Indies has probably gauged the position accurately and will give the Government the benefit of his views. Ill-informed opinion is inclined to cavil at the alleged ill-plight of the British colonial sugar industry and to ask where are all the huge war profits they made when sugar was in the neighbourhood of £100 per ton. One answer is that in many cases this large profit was made by companies registered in Great Britain and as their pre-war profits were not large, the Excess Profits duty came down pretty heavily on them. Moreover, the more progressive of the sugar companies took advantage of their increased revenue to lay out money in improving their estates or getting new machinery—at a pretty stiff price by the way—so when the slump came it was not to be wondered if their reserve funds were not equal to tiding over several adverse seasons of unduly cheap prices. In short, they have not had the financial reserves that other sugar companies, e.g. in Cuba, Porto Rico and Hawaii, built up during more favourable pre-war seasons, under the ægis of a substantial tariff.

The home beet sugar industry has received a very large preference as a temporary measure; the Colonial sugar industry will be keenly disappointed if the Government in the coming Budget does not accord them too some further measure of support. The difficulty is to devise a means that shall not deprive the Exchequer of a considerable amount of money. For this reason it is not considered likely that the Government will concede any further preference. Alternatively, it is being urged that the Imperial preference should remain at its present amount of £18 13s. 4d. per ton, but that the duty on foreign sugar should be increased by the existing amount of the preference—£3 14s. 8d.—to £26 2s. 8d. per ton, thereby doubling the preference without losing any revenue. But this can only be done at the expense of the consumer, and the present price of sugar (thanks to the existing duty of 2¾d. per lb.) is already too high to stimulate consumption. The above increase would probably add another ½d. to the retail price, which would certainly not be a popular step to take on the part of a Government that any day soon may have to appeal to the electors for support. The bait of a reduction in the income tax would not affect the large body of working-class voters to whom the household food budget is the chief consideration. Politically speaking, it would probably pay better to reduce the duty paid on Imperial sugar than to try and get more from foreign sugar. But it remains to be seen whether the Government will do either. The Budget statement is due at the end of April, and till then, we believe, the Government does not intend to make any further disclosures of its fiscal intentions.

Mauritius.

Mauritius too has not escaped the effects of the slump in the price of sugar; she was budgeting in 1919 on the supposition that sugar would remain for some time at £60 to £70 per ton and accordingly felt justified in spending a good deal of money in improving her estates and sugar factory plant. When the fall in prices came, the revenue fell too and some firms got into difficulties and had to place themselves at least temporarily in the hands of official receivers. In no case did the 1921 crop bring in a profit to an estate. The subsequent general order was to curtail expenditure all round; in keeping with this policy few if any estates have passed any orders overseas for supplies for the 1922 crop; anything they absolutely require is being bought locally because local stocks were built up when the exchange was 50 to 60 per cent. in their favour, and now that local traders find themselves overstocked they are selling at prices which are decidedly remunerative to the estates buyers. Local stocks will therefore have to be reduced before there is much incentive to buy again from overseas. But it is thought that by next winter the estates after the wear and tear of two crops will find inevitable repairs and replacements necessitated, and a considerable number of orders may be anticipated on the part of British and other manufacturers and merchants.

A Revival in Cuba.

Activity in sugar production and export in Cuba has developed greatly since the new year, and points to an early recovery from the demoralization that struck the industry of that island in the summer of 1920. As an indication it may be pointed out that whereas the stock of old crop sugar on December 31st was 1,224,000 tons, this was reduced by a million tons by the end of March; in addition the new crop sugars have been selling well. During March receipts at the shipping ports exceeded 200,000 tons per week, but in spite of this the stocks of sugar in the island have shown decreases for three weeks in succession, thus indicating that Cuba has been meeting large demands for sugar from all over the world. The amount exported between January 1st and March 15th exceeded all previous records, amounting in all to 1,400,000 tons. All this augurs well for the disposal of the present crop and the outstanding old sugars, and should give a fillip to the plantings for the 1922–23 season.

The *Federal Reporter* still inclines to a carry-over on January 1st next in the United States of some 1,450,000 tons, but states that the total achieved will depend on the trend of prices during the next few months. It knows of no reason that would justify any material advance in quotations. Meantime HIMELY has raised his forecast of the Cuban crop to 3,580,571 long tons.

The late Mr. John Dymond of the "Louisiana Planter."

Louisiana sugar interests in particular and the cane sugar world in general have suffered a loss by the death at a ripe old age of Mr. JOHN DYMOND, the founder and for 34 years the managing editor of the *Louisiana Planter*. He passed away on March 5th in his 86th year only a fortnight after he wrote what proved to be his last editorial.

JOHN DYMOND was one of the leading figures in Louisiana sugar circles. Born in Canada of Cornish parentage, he early removed with his parents to the United States where he was educated. His first essay in business on his own was in cotton but as this venture did not apparently prosper he gravitated into a sugar and coffee broking business, first in New York and then in New Orleans. Here DYMOND became interested in the cane sugar industry and bought a sugar plantation, Belair by name, which he retained for 39 years. His interest in cane sugar once aroused, he took a leading part in developing the Louisiana sugar industry. He was largely responsible for founding the Sugar Experiment Station at Audubon Park and was prominently connected with the formation of the Louisiana Sugar Planters Association. But his chief achievement was the starting of the *Louisiana Planter* in 1888. Conceived as its name implies with the object of assisting the local sugar industry, this weekly journal gradually developed till it became the leading *cane* sugar publication in the United States. Its principal rival was originally started, if we recollect aright, to further the interests of the indigenous beet sugar industry, and has since developed into an organ devoted to sugar without distinction of source (as did the *Sugar Cane* when it enlarged its activities and became the *International Sugar Journal*). But the *Louisiana Planter* consistently stuck to its first love, cane sugar, though it extended its geographical ramifications and ended by taking an interest, mainly from the planter's point of view, in the industry all over the world. Cuba which was a near neighbour of Louisiana came in for particular attention the last decade, and JOHN DYMOND started a Spanish edition of his paper to meet the needs of the Spanish-speaking planters in Cuba and elsewhere in Latin America. The *Louisiana Planter* has always been a DYMOND family organ and has reflected strongly the owner-editor's definite views. Politically he was a convinced Democrat and stuck to his creed when at one period practically all his sugar confrères went over to the Republican party on the tariff question. He became a Senator in the State Legislature and in that capacity also did much to further the interests of the sugar industry. By his death the industry loses a pioneer of progress and one of its leading pillars.

Increased Indian Tariffs.

A committee which has been sitting in India for some months to consider ways and means of increasing taxation so that the Indian revenue can balance expenditure has been advocating a higher tariff wall in preference to any increase in the inland or excise duties. This is not surprising when we consider that the committee was largely composed of men of a protectionist school of thought, imbued with the desire to aid the native manufacturer and mill owner. Some of the proposals would appear to be already adopted by the Indian Government for their 1922 Budget. Thus sugar imports which, in 1916, bore an *ad valorem* import duty of only 5 per cent., raised in 1917 to 10 per cent. and in 1921 to 15 per cent., are now to be subjected to a 25 per cent. *ad valorem*. This increased impost will chiefly hit the trade of Java and Mauritius, and will not be acceptable to the latter colony just at a time when she is finding a difficulty in disposing of her present crop of sugar at a remunerative price. The duty should, however, do something to encourage the extension of sugar factories in India, always a matter of some difficulty.

Sugar apart, home opinion is inclined to criticize the Indian tariff proposals because they tend to hit the mother country severely, since she supplies more than half the total imports, and last fiscal half-year paid 61 per cent. of the import duties. But India of course has now been given a measure of self-government and Downing Street can no longer ride roughshod over the wishes of the Indian legislators just to soothe Lancashire or other political prejudices. On the other hand, India will be wise not to go too far in raising tariff barriers against the home country; she would do better to consider the merits of Imperial Preference, and frame her tariff on that basis rather than have one indiscriminate set of import duties.

Indian Sugar Ventures.

Some particulars of two recent Indian sugar ventures are given in the pages of a Calcutta contemporary.[1] One is the Nira Valley Sugar Company, which held its first ordinary general meeting a few weeks ago. This company has been erecting a new sugar factory which it hopes will be ready for working in the coming season, or towards the end of the year. They were fortunate in being able to secure the services of Mr. NOËL DEERR (lent by the Sugar Corporation of India) in the task of drawing up the specifications for the machinery needed for this factory. The tenders passed through the hands of Sir ALFRED CHATTERTON, in London, and the offer of Messrs. GEORGE FLETCHER & Co., LTD., of Derby, was successful, the price being £80,000.

The capital of this company is 30 lakhs of rupees, half of which was underwritten by the Tata Industrial Bank; and five lakhs was subscribed by local cane growers, this being one of the underwriting conditions. It has been decided not to acquire land for growing cane at present, an agreement with the cultivators having rendered this unnecessary. There are some 14,000 acres of land already under sugar cane in the neighbourhood of the factory, and the arrangement is that the cane growers will supply cane to the factory at a rate which will be based on the production of gur. When profits of the company exceed 10 per cent., the cane growers that hold shares and have supplied cane will receive a quarter of the profits. There will be 1000 acres under lift irrigation for which the company will supply water at the rate usually fixed by the Government, which is Rs. 45 per acre, plus pumping costs. Cane from these areas will be supplied to the company on the basis as mentioned above.

Another new Indian venture, though on a small scale, is the Tinnevelly Sugar Works, which is being floated by Messrs. CHARI & Co., with an authorized capital of 25 lakhs, with the object of installing and working a sugar refinery and distillery in the Tinnevelly district of Madras presidency. But the raw material is to be not cane, but palmyra jaggery, which is abundantly produced in the district and the output will only be 10 tons per diem, or 3000 tons per annum. It is, however, intended to manufacture from the molasses industrial alcohol, and, if the latter venture is successful, it will doubtless be extended.

India: Final Crop Forecast.

The Final General Memorandum on the sugar cane crop of India of 1921-22, as issued by the Department of Statistics, Calcutta, states that the area sown to sugar cane in India is estimated at 2,381,000 acres, as against 2,566,000 acres last year, or a decrease of 185,000 acres or 7 per cent. The total yield of raw sugar in the form of gur is estimated at 2,592,000 tons, as against 2,523,000 tons last year, an increase of 3 per cent. Owing to deficient rainfall, weather conditions were not favourable at the beginning of the season; but subsequent rains improved the condition of the crop which is reported to be generally good. The United Provinces comes first in area with 52·7 per cent. of the total; it is expected to yield 1,128,000 tons. None of the other provinces attain to 350,000 tons.

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[1] *Commerce.*

The imports of sugar into India for the three years ending March, 1921, are as follows: 1918-19, 506,684 tons; 1919-20, 408,723 tons; 1920-21, 236,908 tons. Java and Mauritius have been the principal countries of origin.

Scientific Development in the Philippines.

In order to foster the technical advancement of the cane sugar industry in the Philippines, the Bureau of Science of the Department of Agriculture in those islands has come to an arrangement with the Philippine Sugar Centrals Agency (a body described in our last issue) to make use of its very complete equipment to carry on research for the sugar industry in return for certain remuneration to cover expenses.

With this end in view, the Bureau agrees to detail a director of experimental and scientific work to supervise all activities of the Agency in this line and to extend their library and laboratory facilities to the Agency for research work. The latter agrees to pay all salaries and expenses of the special personnel needed for the work and will provide a committee to establish and maintain the necessary organization and relationship to the sugar planters in order that the experimental and field work may be conducted along the most advantageous lines. The benefits of the work will, however, be available for the Philippine sugar industry at large.

The Director of the Bureau has accordingly detailed Mr. H. A. LEE, a former Hawaiian Planters' Association scientist, to direct all the experimental and scientific work done under the terms of this agreement. It is hoped indeed that the work done by the Bureau of Science for the Philippine sugar industry can be developed on the lines adopted by the Hawaiian Sugar Planters' Association Experiment Station at Honolulu; but whereas in Hawaii the planters manage their own station, in the Philippines it is proposed that the Sugar Centrals Agency, on behalf of the planters, shall finance the actual work but that the Bureau of Science with its wide experience and technical resources shall direct it. This co-operative effort offers considerable possibilities for the future advancement of the sugar industry in the Philippines and its progress will be welcomed by all those who take an interest in the scientific side of the industry.

Peru.

H.M. Legation at Lima in the last annual report of the Finance, Industry and Trade of Peru supplies the following notes on the price fluctuations of Peruvian sugar the last 10 years.

The pre-war price of sugar was fairly steady at about 10s. per quintal, f.o.b. Peruvian port. A fall was experienced at the beginning of the war, but from 1915 the price began to rise and at the time of the Armistice was 21s. After that date there was another fall, followed by a rapid rise to 40s. at the end of 1919. During 1920 the price rose to 111s. 6d., an unprecedented figure, and one that will no doubt constitute a record. This occurred in June of that year, and the price gradually fell from that time, reaching 21s. at the end of the year. There was a continuance of the decline during 1921 (with a slight reaction to about 17s. 6d. in August) to the present price of about 12s. This price is probably below the cost of production for the average sugar estate, and if it were not for the reserves of most of the owners arising from their past profits, the situation would be an anxious one. As it is, however, the position has been improved by the general acceptance, of the labour concerned, of reduction in wages, and the sugar producers of Peru are now ready to take advantage of any rise in price. In January, 1921, an additional export tax of 5 centavos per quintal was placed upon sugar exported from the valley of Trujillo, to meet the expenses of municipal improvements in the town of that name.

The same official report states that a large order has been placed by a Peruvian estate for German sugar machinery, the price being about a third less than the lowest British quotation. For many years prior to the war practically all the sugar machinery in Peru was of British origin, German machinery only being found at the German Casa Grande Estate, where it was installed in 1915. German light railway material for use on sugar estates is also arriving in quantity, at very attractive prices.

It may be added here that the Department of Overseas Trade in London are in possession of a list of sugar estates in Peru giving the owners, the name of the estate, and the 1919 production. This list may be consulted by British firms interested, on application to the Department. The list was compiled by the Consul at Callao in order that British manufacturers might send out well-illustrated catalogues, but the latter, he emphasized, "must, of course, be in Spanish."

Progress in Trinidad.

The Colonial Office annual report on Trinidad for 1920 which was only recently published gave an encouraging account of the improvement in the sugar industry of that island. The exports of sugar and its by-products were: Sugar, 47,961 tons valued at £2,656,625 ; molasses, 557,491 gallons valued at £66,441; and rum, 54,965 gallons at £14,225, giving a total value of £2,737,291. The crop showed an increase over that of 1919 with a total value of £1,695,906 in excess of that year. The high prices obtained for sugar enabled the principal factories to effect many improvements in their equipment. The stoppage of Indian immigration has helped to cause more attention being devoted to implemental tillage, and animal drawn implements were much more extensively used both for preparing the land and cultivating the crop. Mosaic disease, so widespread in sugar countries, made its appearance but was proclaimed under the Plant Protection Ordinance and action promptly taken to prevent its spread. At the close of the year a special vote was granted to enable the Department of Agriculture to eradicate it as completely as possible during the dry season of 1921.

As is known, a different tale has to be told of 1921. Owing to the big drop in the price of sugar, that year proved a disastrous one for sugar growers; and unfortunately the present outlook is not promising. The 1921 exports amounted to 46,700 tons of sugar, a slight decrease on the 1920 output.

Errata.—In the abstract of the paper by Dr. C. A. BROWNE and C. A. GAMBLE,[1] the formula for R (16th line from the top) should have the plus sign between P and P'; and the formula for S (12th line from bottom) should have the plus sign instead of the multiplication sign.

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[1] *I.S.J.*, 1922, 101.

Fifty Years Ago.

From the "Sugar Cane," April, 1872.

There was a discussion in this issue of our predecessor on the use of the coefficient 5 for the estimation of the "commercial value" of a raw beet sugar. This figure was used to multiply the percentage of ash present in the raw sugar, and the result was deducted from the sucrose present, in order thus to obtain an indication of the yield of sugar on refining. It does not appear to be known how this coefficient originated; but in this paper it is conjectured that "probably refiners comparing the average of their analyses with the production of their refineries, during a year for example, have remarked that their actual out-turn was inferior to the amount of sugar shown by the polariscope by a quantity represented by five times the weight of the ash which their sugars were supposed to contain, and thus in judging by polarimetric assay and incineration of the probable yield and value of a sugar, they adopted the coefficient 5 without proving that the deficit found in their returns was wholly the result of the salts or partially from other causes operating simultaneously, such as loss of sugar in the char, or in the scum, or from accidents."

In this article it was stated that the true coefficient was at that time about 3·6, analyses having been made of a number of exhausted molasses; so its adoption in the sugar trade, in preference to the value of 5, was urged by the writer of the article. However, his suggestions do not appear to have been followed, seeing that the use of the coefficient remains to the present time in the Continental sugar trade, a coefficient of 3 for the reducing sugars (if not over 0·25 per cent.) being also taken into account.

In a translation of an article by the distinguished chemist DUBRUNFAUT, some particulars were published of his osmose process of exhausting molasses, which was being given a good deal of attention. It was claimed that the yield could be raised from 25 to 35 per cent. of sugar (calculated on the weight of massecuite) at a cost of 1 fr. per 100 kg.; that first-grade sugar only would be made; and that the campaign in the factory would be finished 12–15 days after terminating slicing, the lengthy working up of the after-products thus being obviated. At the time at which DUBRUNFAUT wrote his paper, the process had been put into operation by some of the leading manufacturers of France.

Lastly, a paper was published on the saccharate process of extracting the sugar from molasses, an account being given of the attempts of LEPLAY, PELIGOT and others to work out a commercially successful method. As is known, such a method was not elaborated until many years after; and the history of this phase of sugar manufacture is a record of many failures. One is here recorded, namely, that of the French chemist LAIR, who took out a patent for a process in which he worked at a high temperature, and with molasses solutions of comparatively high density. It was stated that a trial of this process in a factory in Russia had shown that the separation was far from complete, while the coefficient of purity of the precipitate was not high.

Florida as a Sugar Producer.

Quite a number of papers have recently appeared in the transatlantic sugar journals upon the probability of Florida changing from a sporadic syrup producer to a large sugar-making state,[1] and, as the matter is rapidly passing from the purely experimental to the practical stage, a brief reference as to the position as it strikes us may be of interest to our readers. After some years of observational and experimental work, several large factories are being laid down in some of which it is hoped that sugar will be produced during the current season. The part of Florida marked out for sugar production is the extreme southern portion of the peninsula where, it is claimed, a number of advantages exist over the rich Mississippi alluvial valley, where the United States cane sugar industry has hitherto chiefly been concentrated. The climate is said to be better adapted to the growth of the sugar cane plant because of its more tropical nature and the comparative absence of frosts. The growing season is longer by some two months, so that not only can heavier crops be secured but maturer canes with richer juice may be taken to the mill. The soil is surprisingly rich in potential organic nitrogen, although somewhat deficient in mineral plant food, but there are large deposits of the latter within easy reach. It is easily drained and worked, but is perhaps too light for aninal-drawn implements, and motors of the caterpillar type seem to be universal. Irrigation, if needed in certain parts of the year, should be an easy proposition because of the lie of the land. Transport should not be a difficulty, both because of the nearness to the coast and the increasing network of railways being steadily pushed down the peninsula. Lastly, between three and four million acres have been recently reclaimed and are awaiting a crop. Thus far sugar canes have been successfully grown on this land, giving large yields of healthy plants with a sucrose content suitable for sugar production. In view of these conditions, it is not surprising that there are enthusiasts who prophesy a great future for sugar making in the tract, some even going so far as to suggest the gradual withdrawal from Louisiana and a production in Florida which will give enough sugar to feed the whole of the population of the United States. Florida has grown sugar cane for a number of years, but this has been entirely with the object of making syrup, usually on a small scale, so that patches of cane may be met with all over the country, and there is thus a large body of experience to draw upon in the new venture; it is perhaps hardly likely that the varieties at present favoured will be found in the long run to be equally suitable for syrup and sugar, but this will presumably be a matter of experiment in the near future.

The question will naturally be asked why this part of the United States has not already been exploited, and the answer is an easy one. The country was very partially opened up until quite recently, differing in this respect markedly from the Mississippi valley and, what is even more to the point, the Everglades, occupying the southern portion of the peninsula had from time immemorial been occupied by an immense swamp. Lake Okeechobee, one of the largest bodies of fresh water in the States, lies equidistant from the east and west coasts, and its overflow kept the Everglades out of consideration as an agricultural tract. The drainage of this lake, over 700 square miles in extent, undertaken some seven years ago has entirely altered the situation. By this measure, its surface which was 21-23 ft. above sea level was lowered 6 ft., by a radiating system of great canals with concrete locks, completely controlling the water system, but not materially interfering with the lake as a great waterway, or with its important fishing industry; thus the Everglades have been rendered available for cultivation. Meantime, railway communications have been and are still being rapidly extended to the shores of the lake, which are now connected on both sides with main lines passing down the coast. Great corporations have acquired blocks of land, and mills are being completed to deal with considerable acreages already planted and to a certain extent tested as to their sugar-producing capacity.

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[1] *Sugar*, July to December, 1921; *Louisiana Planter*, November 26th, 1921.

When a new tract is opened up for cultivation, other things being favourable, two main factors have to be considered before one can judge of permanent suitability for any such crop as sugar cane, where heavy capital has to be sunk. These are climate and soil. Geographically, there appears to be no reason why the sugar cane should not find itself at home in southern Florida, although of course it is not in the tropics, the natural home of this plant. While Louisiana lies roughly between 29° and 31° north latitude, the Everglades are some four degrees nearer the equator, being, in fact, equidistant between the Louisiana plantations and those of Cuba and Hawaii. They are in the same latitude as Tucuman, South Queensland, the Nile valley, Assam and Bihar, where sugar cane is grown with varying success; and they are actually nearer the equator than Zululand which, by its special situation, can grow good, thick. tropical canes. Everything depends in the countries mentioned above on the local conditions, and chiefly perhaps on the distribution of the adjoining great land masses. Tucuman is in connexion with a southern continent extending into regions of ice and snow, and is, moreover, at a considerable elevation. **ROSENFELD** draws attention to the latter fact,[1] and states that during the past year there have been no less than 44 frosts. South Queensland is subject to occasional frosts and is also liable to droughts of some intensity, so that the general movement in the Australian sugar industry is continuously to the north of this colony. The Nile valley is not subject to frosts, but cotton is the predominant crop, and there is little land available for sugar cane; there is no rain, but abundant irrigation, and good crops are obtained. Bihar does not at present succeed very well with thick canes, and is chiefly concerned with indigenous Indian canes of much poorer character, while Assam, which is the country perhaps most similar to the Everglades in its soil characters, enjoys a milder and more humid atmosphere than most parts of India, and can grow tropical canes of good sugar content. Southern Florida is not free from frosts because of its connexion with the great masses of land to the north, but it is claimed that the great expanse of lake Okeechobee, over which the northerly and north-westerly winds must come, will have an ameliorating effect. On the other hand, the peninsula thrusts itself right into the pathway of the Gulf Stream, and thus acquires, or should acquire, much of the mildness of insular climates. The rainfall is practically that of Louisiana, 58 inches, and should be sufficient. But it is rather unfortunate in its distribution, as pointed out by **ROSENFELD**, in that it increases steadily from winter to autumn, at which time of year as much as 22 inches fall. This is a somewhat serious drawback, but is presumably discounted by the longer growing season, which makes it possible to begin crushing as late as November, with or without a period of windrowing if frost occurs. To anyone accustomed to tropical cane growing the conditions of climate in southern Florida are thus not ideal, though much better than in Louisiana or Tucuman, where great industries have been successfully established.

The soil conditions are of a special character and somewhat similar to those in Assam and seem to us to require very careful consideration. There is an enormous mass of undecayed vegetable matter at hand, and in certain respects the position is analogous to the opening up of land for centuries under a great forest. We know that in tropical forest land the permanent fertility largely depends upon the care taken in the preliminary stages of bringing the land under cultivation, and that it is quite possible within a very few years, by letting in the air, sun and rain, to dissipate the potential stores of nitrogenous food material and render the reclaimed land practically useless. But the forest has this advantage over the Everglades that, while in the latter the organic matter overlies pure sand, that in the forest generally has a more clayey substratum. Much will depend upon the care with which the land in Florida is opened up, and this aspect has not perhaps received the amount of attention which it deserves. HINES[1] has given a very interesting and detailed account of the constitution of the soil in the tract and the effect which draining has had upon it. Broadly speaking, there is an immense accumulation of organic remains on the surface, with a general deficiency of mineral plant food; this is underlain by pure sand, which in turn gives place to thick layers of marl. The organic matter ranges from 1 to 16 ft. in thickness, with an average of four to six. Its main source is the age-long growth of a gigantic rush, called "sword grass" *Cladium effusum*, which completely takes up the ground. Alternating wet and dry seasons have induced the plant to die down and to grow with renewed vigour upon the ruins of its former self; and the latter, being largely covered by water, are so to speak hermetically closed against the entrance of air and the resulting action of decomposing bacteria. The organic matter is thus inert. When the land is drained and the soil dries, the rush dies; its place is first taken by a mass of coarse growing weeds, the largest and commonest of which is called "careless" or "pig weed," *Amaranthus retroflexum*. One plant recently measured was 16 ft. high and 10 in. in diameter at the base. Under this weed flora and in the absence of the sealing influence of the surface water, bacterial action is rendered possible, and rapid decomposition of the organic matter commences. If dry soil conditions continue, the weed flora naturally passes into a growth of elder, *Sambucus canadensis*. The soil becomes mellower and, on old elder lands, sugar cane can be grown. Yet a further stage occurs if the land is left to nature, and custard apple, *Anona glabra*, becomes the dominant feature, being intertwined with species of Ipomaea, together forming typical tropical jungle with a continually improving soil. If, however, sword grass soil is drained and cleared for cultivation, these changes are passed through much more rapidly, and although sugar cane cannot be immediately planted the growth of potatoes, corn, and rice quickly brings it into a more or less suitable condition. But, on general principles, one would much prefer the more gradual action of nature and, as there do not appear to be any data as to what is going on in the soil during the changes above mentioned, it appears to us advisable that such should be obtained as soon as possible by experiment. Until this is done, agriculturists interested on the permanence of the fertility of the tract may be excused for feeling some misgiving. It is, however, generally recognised in the tract that it is important in the dry period of the year to keep the ground covered, and it is claimed that, in case the nitrogenous material becomes too rapidly depleted, leguminous crops have been shown to grow very well. We must leave it at that, and sincerely hope that the early promise of this important sugar tract may be fulfilled in due course.

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[1] *Sugar*, November, 1921.

C. A. B.

Estate of the gross value of £1,114,108 was left by the late Sir WILLIAM HENRY TATE, Bart., formerly Chairman of Messrs. Henry Tate & Sons, Ltd., of London and Liverpool. Sir HENRY TATE, first Bart., who died in 1899, left £1,263,565.

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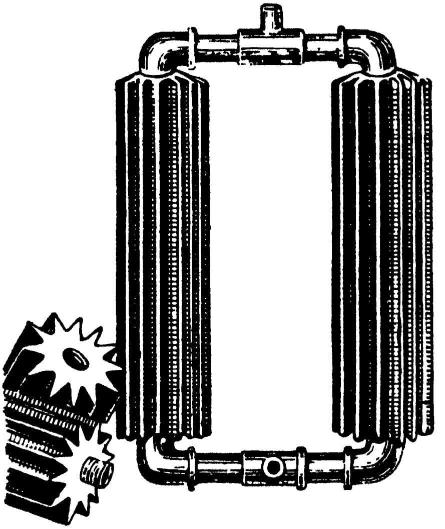
[1] *Sugar*, July and October, 1921.

Ribbed Heating Tubes for increasing the Efficiency of Evaporators and Vacuum Pans.[1]

Writing in a Russian technical journal dealing with sugar manufacture,[2] A. A. SCHUMILOW discusses the feasibility of completely utilizing the cheap juice vapour from the first vessel of the evaporator for the boiling of the massecuite in the vacuum pans. In endeavouring to realize this possibility, he advises the use of tubes which are ribbed; and he has carried out experiments in the laboratories of the Kharkof Technical High School, as well as in the Rschewka-Pawlowski Sugar Factory.

LABORATORY EXPERIMENTS.



In the laboratory experiments, a small vacuum pan was used. Part of its heating surface which consisted of two brass coils of 0·134 sq. m., was replaced by a ribbed tube (also of brass) of 0·05 sq. m., and a small coil of 0·03 sq. m., that is a total heating surface of 0·08 sq. m., or 40 per cent. less than originally. Nevertheless, the massecuite did not take longer to boil than previously, while calculation showed that the coefficient of transmission of heat for the ribbed tubes had risen by about 15 per cent. in comparison with that for the ordinary coil tubes which they had replaced.

These ribbed tubes had an internal diam. of 20 mm. (nearly ¾ in.), and an external diam. over the ribs of 62 mm. (nearly 2⅜ in.); the number of ribs was 12; their thickness at the base was 5 mm. (nearly ¼ in.); and at the point, 2 mm. ($\frac{1}{12}$ in.), and the depth of the space between the ribs was 16 mm. (⅝ in.)

When the massecuite was dropped from the pan, one could see that the whole surface of the ordinary coils was covered with an incrustation 2 mm. ($\frac{1}{12}$ in.) thick; whereas the surface of the ribbed tubes, on the contrary, remained free from deposit. Circulation during boiling had taken place in the direction of the ribs of the tubes.

FACTORY EXPERIMENTS.

For the factory experiments, a special pan was built, the diam. of which was 800 mm. (31½ in.), and the height of the cylindrical part 1800 mm. (5 ft. 11 in.). It contained 20 cast-iron ribbed tubes, the heating surface of each of which was 0·25 sq. m., giving a total of 5·0 sq. m. Each tube had 12 ribs, the diam. of which was 32 mm. (1¼ in.), the external diam. including the ribs, 100 mm. (nearly 4 in.), the thickness of the walls, 4 mm. (⅙ in.); and the height of the tubes 340 mm. (13⅜ in.). The ribbed tubes were connected together by ordinary smooth tubes (as shown in the Fig.), the steam being introduced from above, and the condensed water led off from below.

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[1] Translated from the *Centr. Zuckerind.*, 1922, 674. [2] *Zapiski*, 1914, 8.

The ribbed tubes were divided into two groups, and installed partly in the lower conical portion of the pan, and partly in the cylindrical space, 14 tubes forming the first and six the second group. Steam was introduced separately into each group of tubes from above through a common pipe; and boiling was carried out with exhaust and also with live steam. Altogether nine experiments were carried out, but the results of four only are here reproduced:—

					Temperature					
Weight of Syrups, kg.	Weight of Massecuite, kg.	Duration of Boiling, hrs. min.	Brix of Massecuite.	Steam used.	Of the Steam.	Of the Boiling Massecuite.	Temperature Fall.	Temperature of of Condensed Water.	Weight of Water, kg. per min.	Transmission-calories.
1313·7	819·0	3 25	92·71	Live	132·8	—	—	131·5	2·80	6·20
1474·2	917·3	3 50	94·09	,,	132·6	84·9	47·7	131·2	2·84	6·45
1228·5	756·8	4 30	91·34	Exh't.	113·6	73·3	40·3	111·5	2·10	5·62
—	—	2 5	94·55	Live	131·3	84·2	47·1	123·0	2·00	5·57

These results demonstrate the suitability of the use of ribbed tubes for the transference of heat to the mass undergoing evaporation. Moreover, it was shown that the massecuite does not obstruct the spaces between the ribs at any concentration encountered in practice; and that in no case was the transmission value lower than the average obtained with smooth tubes.

Lastly, this Russian writer gives several sketches of different forms and arrangements of cast-iron heating tubes with solid and with hollow ribs, pointing out that the use of these instead of those having the customary smooth surface constitutes a considerable improvement, the result of which is either to hasten the boiling of the massecuite when working under ordinary conditions, or to enable one to employ the cheaper juice vapour in place of the dearer fresh steam.

The Maintenance of Sugar Making Plant and Machinery.

By C. W. BRETT, Managing Director, Barimar, Ltd.,
The World's Scientific Master Welders.

The method employed to maintain machinery in commission has considerable bearing upon the strength or weakness of the balance sheet; in other words the annual repair bill is a heavy item or a light item according to the judgment shown by the works manager, the director of production, or the machinery user and owner.

To this rule the sugar manufacturing industry is no exception, and many manufacturers are seriously handicapping a trade which even now is none too robust, as the result of war conditions and low prices, by their failure to give this important question the consideration it deserves.

Many, for example, rely upon a process of "scrapping and replacement" to make good disablement; seemingly it has never occurred to them that replacement is not really a repair, but the part-purchase or purchase of a new whole. Moreover, replacement, so far as new parts or components are concerned at least, does nothing to recondition or restore the *whole* machine to its original efficiency. This is a serious disadvantage, since when one part gives out the other parts—though they may not have reached the breaking point—are also suffering from the effect of wear-and-tear and incessant vibration, and are, therefore, in a condition to give trouble at almost any moment.

So much for replacement. What then is the proper procedure? The answer is unescapable. There exists only one genuine method of mechanical repair or metallic reconstruction, only one system by the employment of which every mechanical device—used for whatever purpose—fabricated of any of the industrial metals can be restored to full service rapidly, efficiently, economically, and permanently, and that is by the application of Scientific Welding.

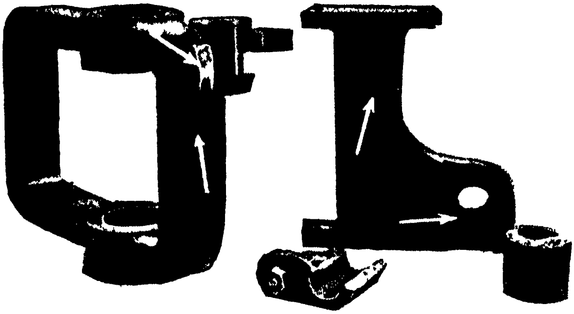

FIG. 1.
THIS CAST-IRON BRACKET IS BROKEN THROUGH THE BEARING AND BOSS.

For this statement we make no apology; it is not a matter for argument, but a question of fact. The broadest claims may be made on behalf of mechanical reconstruction by means of welding, and every claim can be substantiated.

Did space permit we could append a list of devices used in the sugar industry which have been reconditioned equal to new, often in a few days, at a cost which was merely a fraction of the charge for replacement. We could furnish also proofs that machinery so repaired stands up to every demand that can reasonably be made upon a new unit or component.

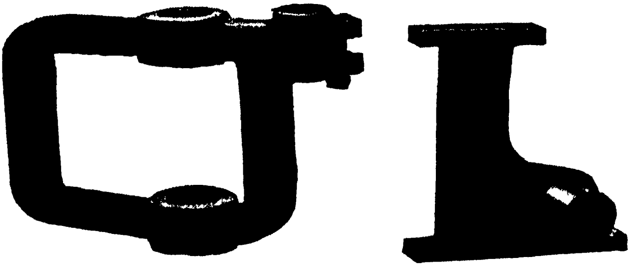

FIG. 2.—THE SAME BRACKET AFTER REPAIR BY SCIENTIFIC WELDING.
WHEN MACHINED AND LINED UP THERE WAS NO TRACE OF THE REPAIR.

Welding, of course, is a comparatively new process; but it has long since passed the experimental stage, and most reputable firms of welding specialists are willing to guarantee 98 per cent. of accepted work.

There is one important thing to remember, however, and that is that 100 per cent. efficient work requires 100 per cent. efficient operators. A 50 per cent operator can do more damage in half an hour than can be put right by a specialist in a fortnight. Hundreds of valuable machines are annually ruined by the bungling and mishandling of incompetent craftsmen. It is not a question of cheaper repairs, but of *proper* repairs. Anybody having the requisite appliances can unite two pieces of metal by fusion; but to unite them so that they retain all their former strength and physical qualities is essentially work for the specialist—that is to say the metallurgical expert.

Economy in the Use of Water.[1]

By HERBERT WALKER.

MACERATION.

One of the hardest problems in a sugar factory is to determine how much maceration water it is profitable to apply at the mill. The three most important factors entering in the calculation are (1) the gain in sucrose extraction resulting from each increase of 1 per cent. of maceration water; (2) the net value of 1 per cent. increased extraction based on a definite weight of cane and on current sugar prices; (3) the cost of the extra fuel required to evaporate the water due to 1 per cent. maceration.

(1) This is a factor that should be worked out by trial at each individual factory, a very hard thing to do, owing to the difficulty of maintaining all other conditions the same while varying the amount of maceration water. In the absence of better data, the following, derived from several curves based on theoretical values for a 12-roller mill, may be of some help, though it makes no pretence of being more than a very rough approximation.

If maceration water per cent. cane is increased from: per cent.	Increase in extraction will be about: per cent.
20 to 30	0·8
30 to 40	0·3
40 to 50	0·2
50 to 60	0·1

(2) A table showing the value of increased extraction, based on a recovery as commercial sugar of 75 per cent. on the weight of sucrose extracted, and a total cost for containers, freight and marketing of 1 cent. per lb. has been compiled as follows:—

TABLE I.

Value of a 1 per cent. increase in extraction for each 1000 tons of cane ground.

Market price of 96° sugar, cents per lb.	Polarization of Cane. 10 per cent. $	11 per cent. $	12 per cent. $	13 per cent. $	14 per cent. $	15 per cent. $	16 per cent. $	17 per cent. $
4	45	50	54	58	63	68	72	76
5	60	66	72	78	84	90	96	102
6	75	82	90	98	105	112	120	128
7	90	99	108	117	126	135	144	153
8	105	116	126	136	147	158	168	178

(3) The cost of extra fuel for evaporating will vary somewhat in different factories, but a fairly good average figure is obtained by assuming that the oil burned in the bagasse furnaces as the auxiliary fuel yields 4000 lbs. of steam per 42 gallons of oil. This is decidedly less than is considered good practice, but is probably better than is obtained in most sugar factories unless furnaces especially designed for oil burning are used. If evaporation is done at quadruple effect, 1 lb. of steam will heat and evaporate about 2·5 lbs. of water; if at single effect about 0·9 lb. of water. So each additional ton of maceration water added requires 0·2 barrel oil for heating and evaporation at quadruple effect, or 0·556 barrel at single effect.

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[1] Paper presented to the Committee on the Manufacture of Sugar and Utilization of By-products, appointed by the H.S.P.A.

TABLE II.

Cost of Heating and Evaporating 10 Tons of Water.

[which is equivalent to 1 per cent. maceration or practically to 1 per cent. dilution of normal juice on 1000 tons of cane. Each 1 per cent. maceration means 2 barrels oil burned per 1000 tons cane.]

	$	$	$	$	$	$
Cost of oil per barrel	1·00	2·00	2·25	2·50	2·75	3·00
Cost of evaporation at quadruple effect	2·00	4·00	4·50	5·00	5·50	6·00
Cost of evaporation at single effect ..	5·56	11·12	12·51	13·90	15·29	16·68

In the practical application of Tables I and II, assume that a mill is getting 97·0 extraction from cane of 14 polarization with only 20 per cent. dilution, and is burning no extra fuel. To what extent could the dilution be profitably increased? If increasing the dilution to 30, 40 and 50 per cent. respectively yields extractions of 97·8, 98·1 and 98·3 (and this should be thoroughly tried out before any decision is made), the additional increments of extraction would be worth, with sugar at 6 cents per lb., 84, 32 and 21 dollars respectively per 1000 tons of cane. Each increase of 10 per cent. in addition with oil at $2·50 per barrel would cost $50 for evaporation at quadruple effect, so that in this particular case increasing to 30 per cent. would pay a profit of $34 per 1000 tons of cane, while a further increase from 30 to 40 per cent. would cause a loss of $18 per 1000, and an increase from 40 to 50 per cent. would cause an additional loss of $29 per 1000 tons.

In this case it would seem most profitable to keep the dilution about 30 per cent., though factory conditions might be such as to change this conclusion. For instance, if exhaust steam is going to waste in spite of ample evaporator capacity, it will always be in order to put on enough extra maceration water to take care of it. On the other hand, if the evaporator heating surface in the above example were under capacity so that at anything over 20 per cent. dilution the syrup had to be sent up thinner and evaporation completed in the pans, the cost of evaporation for each 10 per cent. increase would be $139 instead of $50, and the best paying dilution would be about 20 per cent.

TABLE III.

Increased Extraction which must be produced by each additional 10 per cent. maceration in order to yield a profit.

[based on a net value of 96° sugar at the mill of 5 cents per lb., or a market price (duty paid) of 6 cents. Evaporation at quadruple effect. If evaporation is at single effect, multiply all values in the table by 3.)

Polarization of Cane.	Cost of Fuel Oil per Barrel					
	$1·00	$2·00	$2·25	$2·50	$2·75	$3·00
	Increased extraction required to pay for 10 per cent. dilution.					
	per cent.	per cent	per cent.	per cent.	per cent.	per cent.
10	0·33	0·67	0·76	0·83	0·91	0·98
11	0·30	0·60	0·67	0·74	0·81	0·89
12	0·28	0·56	0·61	0·68	0·76	0·81
13	0·26	0·52	0·57	0·63	0·70	0·76
14	0·24	0·48	0·54	0·59	0·65	0·70
15	0·22	0·46	0·50	0·55	0·61	0·65
16	0·21	0·42	0·46	0·52	0·57	0·61
17	0·20	0·39	0·43	0·48	0·54	0·57
18	0·19	0·37	0·41	0·46	0·50	0·55

The above table gives a rapid means of calculating whether an increase in maceration water is likely to be profitable. Suppose a mill is grinding cane of

14 per cent. sucrose and is paying $2·50 per barrel for fuel oil. If, on increasing the maceration 10 per cent., a gain of more than 0·59 per cent. in extraction results, the increase is worth while, provided sufficient evaporator capacity is available to keep the syrup up to the proper density, otherwise about three times as much gain in extraction would be required. These figures, of course, hold good only for a net value of 5 cents per lb. for sugar at the mill. If the market price of sugar (x) varies from 6 cents, multiply percentages in the table by $\frac{5}{x - 1.}$

LOSS BY SHUTTING OFF MACERATION WATER.

The decided loss sometimes caused by carelessness of operatives in too frequent manipulation of the water valve as a cure-all for roller slippage, or in unnecessary prolongation of dry crushing tests, is shown by the following calculations:—

Reducing maceration from 30 per cent. to nothing will cut down the extraction, say, from 98 per cent. to 88 per cent. or 10 per cent. loss on cane of 14 per cent. sucrose, or 0·014 ton of sucrose per ton of cane, from which 85 per cent. or 0·0119 ton of could have been made. At $100 per ton this amounts to $1·19 per ton of cane, or approximately this much for every minute the water is shut off. The saving in evaporation during the same time is 0·3 ton of water or about $0·15.

FILTER-PRESS WASHING.

The amount of water used for washing filter-press cake is generally figured in gallons per ton of cake. The cost of heating and evaporating 100 gallons of water at quadruple effect is about one-tenth the cost of oil per barrel. The value of 1 per cent. of sucrose left in 1 ton of press-cake is about 0·0075 times the net value of a ton of sugar at the mill (i.e., the net value of 15 lbs. sugar recovered).

If 500 gallons water per ton of cake are being used, leaving, say, 1 per cent. sucrose in the cane, and it is found that 700 gallons water per ton of cake reduce this to 0·6 per cent., the saving in sugar at $100 net per ton is $0·30 per ton of cake. The cost of evaporating the additional 200 gallons of water with oil at $2·25 per barrel would be 0·45, leaving a net loss of 15 cents per ton of cake.

The following table, worked out for various prices of oil and sugar, shows how much the polarization of press-cake should be reduced to pay for evaporating each additional 100 gallons of water per ton of cake:

Market price of 96° sugar,	Cost of Oil per Barrel					
	$1·00	$2·00	$2·25	$2·50	$2·75	$3·00
	Decrease in polarization of press-cake required to pay for each additional 100 gallons water per ton of cake.					
cents per lb.	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.
4	0·19	0·37	0·42	0·47	0·51	0·56
5	0·14	0·28	0·31	0·35	0·38	0·42
6	0·11	0·23	0·26	0·28	0·31	0·34
7	0·09	0·19	0·21	0·23	0·26	0·28
8	0·08	0·16	0·18	0·19	0·22	0·24

With 1921 prices for sugar and oil each successive addition of 100 gallons of wash water to a ton of mud-cake should remove about 0·4 per cent. sucrose in order to pay for its own evaporation.

DILUTION OF MOLASSES.

Considerable fuel is sometimes wasted in evaporating excess water used in diluting molasses and remelting low-grade sugars for reboiling. It is customary in some countries to dilute all molasses to be reboiled down to about the density of the syrup, or, say, 60° Brix. This is an advantage in making it easier to maintain a good circulation in the pan with less danger from false grain. Most Hawaiian factories to save steam, heat and dilute their molasses only enough to dissolve all grain before reboiling.

The possible saving in fuel depends much on the amount of molasses boiled back, and therefore on the purity of the juice. In one factory the total massecuite is 177 per cent. of the syrup massecuite, which latter is 14·7 per cent. on the weight of the mixed juice. The molasses and remelt boiled back is $77 \times 96/90 =$ about 80 per cent. of the syrup massecuite, or, say, 12 per cent. on the juice or 14 per cent. on cane.

If diluted from 90° to 60° Brix before reboiling, 7 per cent. more water on cane would have to be evaporated, requiring nearly 40 barrels of oil per 1000 tons of cane. If the molasses is diluted to 80° Brix only, ¾ this extra evaporation is saved, leaving a total fuel cost of 10 barrels oil per 1000 tons of cane, which in this particular factory would amount to about $4500 for the crop.

Instead of water for diluting and remelting, mud-press washings, mud-press juice, or clarified juice are sometimes used, but where such thin juices are drawn intermittently through long pipe lines the sucrose lost by inversion may be worth more than the steam saved. If molasses be diluted from 90° to 80° Brix with 15° Brix clarified juice instead of water, the net saving in steam is about 32 per cent., or 3 barrels oil per 1000 tons of cane. Theoretically, 100 per cent. steam saving might be effected by using syrup as the diluent instead of water. Practically it would require equal parts of 70° Brix syrup and 90° Brix molasses to make a mixture of 80° Brix, which would raise the purity of the molasses too much. Where an increase in purity is no objection, as in remelting low-grade sugar, the use of syrup and just sufficient water to dissolve the sugar may be a little more economical and somewhat safer than thin juice alone.

CONCLUSION.

These calculations and tables were originally worked out with the idea of establishing a more definite relationship between the values of increased extraction and of fuel oil. It is recognized that local conditions may vary these values enormously.

For example, a mill which is so fortunate as to need no extra fuel should, of course, increase its dilution up to the point where extra fuel is needed. Where power requirements are so great that an excess of exhaust steam is produced, it is always in order to add enough water to condense all the exhaust, provided evaporators have sufficient capacity to handle the increased evaporation and still deliver about 70° Brix syrup. Where pan capacity is so large that all the boiling is done with exhaust steam, a high syrup density is not so essential. A factory having a large pan and a relatively small evaporator capacity, with an abundance of exhaust steam, might even do better to send up a rather thin syrup, thus recovering at least a portion of the heat from the exhaust in a hotter feed water. Of course, the best remedy in this last case would be to improve power conditions so as to cut down the amount of exhaust steam produced.

The values for extraction were based on a recovery as 96° sugar of 75 per cent. of the extra extraction, assuming that the last increment is extracted at a purity of about 68°, about the average of the last mill juice in Hawaii. If the last mill juice varies much from this, a correction may be made. Where the last mill juice purity drops below 54°, for instance, it is only possible, theoretically, to recover about half the extra sucrose extracted, and only two-thirds as much maceration as the tables indicate would be allowable.

Economy in the Use of Water.

It is somewhat difficult to reduce maceration to a desired limit on account of mechanical difficulties. The shredder, together with deep-grooved feed rolls, pulverizes the cane so well that as Messchaert grooves become worn an increasing amount of fine trash falls into the mill bed, necessitating more maceration water to carry it away.

Economy in Milling.[1]

By L. W. HOFLAND.

According to Mr. Böhtlingk the economical limit is reached when the relation between pressure and juice expression ceases; in other words, when in order to obtain a small increase in juice extraction the pressure needs to be increased out of all proportion.

For practical purposes, however, I believe that another limit must be considered. What does it cost us to obtain the last picul of sugar expressed out of the cane (for instance, the 97th of the 100), and at what price do we sell this picul? To make clearer what I mean, I shall use a rough example. Assume that with a certain installation I can get an extraction of 94 and that this installation cost 100,000 guilders. With an installation of 150,000 guilders I can increase the extraction to 95. In the cost accounting of that "last picul" enters all extra cost of the heavier installation.

Assume a factory producing 95,000 piculs of sugar; then therein are 1000 "last piculs." Take for the increased upkeep 500 guilders per annum; and for the depreciation of the extra 50,000 guilders, 5000 guilders. And take for the cost of production per picul of the cheaper installation 5·50 guilders. Then for the "last piculs" this will be as follows:

$$5{\cdot}50 + \frac{5500}{1000} = 11 \text{ guilders.}$$

Even when the cost per picul of these "last piculs" runs up to 25 guilders, the required installation would pay for itself under the present price conditions, because even these "last piculs" would yield a profit.

However, it is not sound business sense to count on such prices for the future, and as a limit for production cost of these "last piculs" we must take, for instance, 12 guilders. Whether or not these "last piculs" are obtained by a greater pressure is not the point; but whether they can or cannot be sold at a profit, that is what counts. If, therefore, such a calculation could be made as easily as illustrated in the example above, it would be an easy matter to calculate the most economical milling installation for a new factory.

Unfortunately we cannot make the calculation because neither the machinery dealers nor the technical factory staff is able to furnish with sufficient accuracy the different possible extractions for the different installations of various capacity.

The problem to obtain accurate data is extremely difficult because the results of the different factories are not comparative on account of differences in the installation, either in entirety or in part. Furthermore, such widely different mill settings are used, and in short the number of variables of influence is so large that accurate information could only be obtained after a careful study of the different equipment. This would take years. The Java Experiment Station, through Mr. Bolk, has done much to assist in this direction by determining a normal extraction for each installation, but as this figure does not take into consideration all factors of influence the proper solution has not yet been found.

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[1] Translation of a paper originally published in the *Archief*, June, 1920, and printed in the Report of the Committee on Manufacture of Sugar and Utilization of By-Products, of the Hawaiian Sugar Planters' Association, 1921.

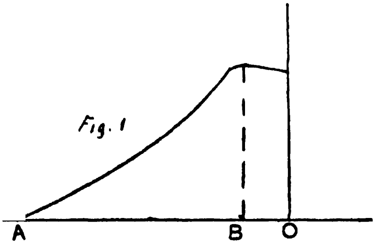
To obtain a good insight in the extraction, we must first find all the factors and study each of them separately. These factors can be divided in eight groups :—(1) Feeding, (2) Grinding capacity, (3) Mill installation and preparatory machinery, (4) Gearing, (5) Engine, (6) Control, (7) Cane, and (8) Maceration.

Every one of these groups consists of a number of factors which each again must be checked separately. As it would take too much time to deal with all of them, and as much is already known, I shall deal with a few only of which I have to say something especially.

REABSORPTION.

By reabsorption in a mill we understand any escape of expressible juice through the smallest opening. In practice we consider an escape of juice only when the quantity is so large as to be noticeable to the eye (by wet spots on the top roller), although this phenomenon must take place in a lesser degree long before it is visible.

Reabsorption is one of the most important factors controlling the possible juice expression with a mill or train of mills. First of all, then, we must trace its cause. Since we know that juice never runs from a lower to a higher pressure, we may conclude that the place of maximum pressure when the juice escapes through the smallest opening must be just in front of the same and the pressure lines will run somewhat as represented in Fig. 1.

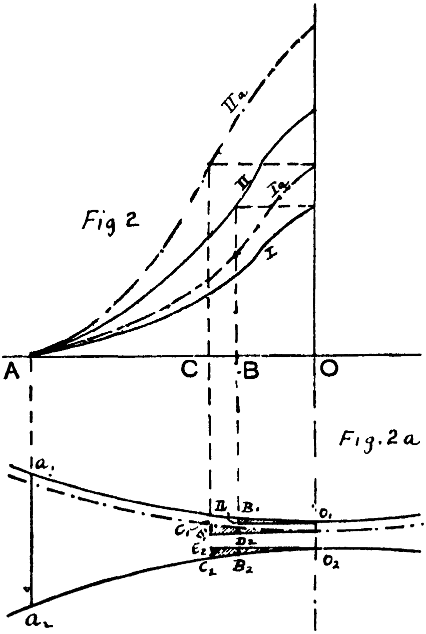


The expressible juice which is present at that time on the line BO must escape to the right, therefore, through the smallest opening. But the pressure on BO does not necessarily need to decrease from B to O; even if the pressure decreases from O to B it can happen that juice escapes through the smallest opening, because, when this pressure reduction from O to B is such that a relative juice velocity is created smaller than the circumferential roller speed, then the juice will escape through the smallest opening with the passing bagasse. *This is therefore one reason to run with a low circumferential roller speed.*

Seeing, then, that the reabsorption is caused by a peculiar pressure curve the cause of this special pressure relation remains to be solved. This can be due to nothing else but local irregularity of the bagasse blanket. Even a blanket perfectly regular to the eye will have local differences in the quantity of fibre per square inch, and a pressure curve as illustrated above is thus easily explained. On a spot with accidentally much fibre, the pressure increases at a further distance away from the narrowest opening than it reaches at the narrowest opening by a part with little fibre. This is further explained if we lay out (Fig. 2, I and II) the pressure curve for a part with little fibre and a part with much fibre, as it is bound to run through the pressure tract.

We can then easily show the spot where the two pressures become equal, or the part B O of the pressure tract, wherefrom the contained and still expressible juice may escape under certain conditions through the narrowest opening, which quantities $O_1 B_1 D_1 + O_2 B_2 D_2$ are illustrated in Fig. 2a.

The larger the local unevenness, the greater the difference between the spots with the most and the least fibre per sq. in.; and the larger the difference between the lines I and II, and the greater the distance from B to O, or the longer the tract where reabsorption (i.e., the tract where juice motion to the right can take place), the greater the quantity of expressible juice not recovered due to reabsorption. Decreasing the opening coincides with an increase of reabsorption.



If we study the case as illustrated in Fig. 2 by the lines I and II, then with a closing up of the rollers (shown by the dotted line indicating the roller circumference in Fig. 2a) the curves for the pressures in these two cases will run as illustrated in the Fig. 2 by the lines Ia and IIa. We see that now a greater part of the pressure tract O C under certain conditions will dispose of its juice through the narrowed opening, which in Fig. 2a is illustrated by $O_1 C_1 E_1 + O_2 C_2 E_2$, thus meaning an increase in reabsorption, for which $B_2 C_2 E_2 D_2$ is a measure. With a close setting the quantity of "theoretically expressible" juice increases. I mean by "theoretically expressible" juice the quantity of juice present originally, minus that quantity of juice, passing through the narrowest opening with the velocity of the bagasse (circumferential speed of rollers), whereas this juice takes up the entire space in the narrowest opening not occupied by the fibre, and this space per cm. roller length and per cm. revolution amounts to (f—f') c.c., in which f = the height of the narrowest opening; and f' = the height of the fibre when this is all together in compact form.

We have then for the "theoretical quantity of expressible juice" per cm. roller length and per cm. revolution : J — (f—f') c.c., or J + (f'—f) c.c., where J is the height which the juice would take in the bagasse before the bagasse is gripped by the roller, when this space is expressed as if it were altogether in compact form.

From the formula we see that by decreasing the narrowest opening (in other words, when decreasing f) the quantity of "theoretically expressible juice" increases. Changing the narrowest opening causes two contradictory influences on the pressing: First, the quantity of "theoretically expressible" juice; second, the reabsorption losses. The resultant of these two influences gives us the actual pressing; which can be found by deducting the reabsorption losses from the theoretically expressible juice.

The maximum possible "actual pressing" will therefore be found at such an opening where the quantity of "theoretically expressible" juice minus the reabsorption losses is a maximum. This maximum is entirely controlled by the reabsorption losses (and therefore by the factors influencing the latter), because the quantity of "theoretical expressible" juice for a definite blanket thickness $(J + f')$ is a constant and is known for every opening and entirely independent of any irregularity in the bagasse blanket, circumferential speed, etc.

As explained before, the quantity of "theoretically expressible" juice per c.c. roller length and per cm. revolution is: $(J + f' - f)$ c.c. Taking 50 cm. roller length per cm. revolution, assuming $J = 4{\cdot}5$ cm. and $f' = 0{\cdot}5$ cm., we have :—

f = 5 cm., quantity of "theoretically expressible" juice = 50 (5— 5) = 0 c.c.
f = 4 cm. ,, ,, ,, ,, = 50 (5— 4) = 50 c.c.
f = 3 cm. ,, ,, ,, ,, = 50 (5— 3) = 100 c.c.
f = 2 cm. ,, ,, ,, ,, = 50 (5— 2) = 150 c.c.
f = 1 cm. ,, ,, ,, ,, = 50 (5—10) = 200 c.c.
f = f' = 0·5 cm. ,, ,, ,, = 50 (5-0·5) = 225 c.c.

With openings smaller than f' we need not concern ourselves, as they cannot occur in practice. When we plot these values vertically above the corresponding openings, we get a straight line curve, representing the quantities of "theoretically expressible" juice for the different openings.

The maximum quantity of actually expressible juice per cm. roller length and per cm. revolution we have assumed to be 125 c.c., which pressing is reached when f equals 1 cm. With the aid of this curve the quantity of actually expressible juice for the different openings can easily be deduced and runs as follows :

f = 5 cm. 0 c.c.
f = 4 cm. 50 c.c.
f = 3 cm. 90 c.c.
f = 2 cm. 115 c.c.
f = 1 cm. 125 c.c.
f = 0·5 cm. 117 c.c.

REABSORPTION LOSSES.

As the theoretically expressible juice minus the reabsorption losses equals actually expressible juice, it must be true that theoretically expressible juice minus actually expressible juice equals reabsorption losses. When we therefore deduct from the theoretically expressible juice corresponding with a certain opening, the actually expressible juice belonging thereto, we get the quantity of juice lost by reabsorption. Per cm. roller length and per cm. revolution we have :—

f = 5 cm. 0 — 0 = 0 c.c.
f = 4 cm. 50 — 50 = 0 c.c.
f = 3 cm. 100 — 90 = 10 c.c.
f = 2 cm. 150 — 115 = 35 c.c.
f = 1 cm. 200 — 125 = 75 c c.
f = 0·5 cm. 225— 117 = 108 c.c.

If we plot these quantities vertically against the corresponding openings, we get a curve representing the reabsorption losses for the various openings. It is not a constant line, but depends on various factors as local irregularities, circumferential roller speed, etc. Therefore this line, or the reabsorption losses, or, better still, the local irregularities, etc., completely control the maximum actual pressing and the spot where this is reached. Thus I have tried herewith to justify what has already been said, namely that: Reabsorption is one of the most important factors controlling the pressing with a mill, and therefore of the entire mill train. Or, rather, I have tried to explain my idea of what happens with the squeezing of bagasse between two rollers as far as juice-expressing is concerned. This theory has still to be proven by what has been found in practice, from which must then follow the truth of the hypothesis. If it holds good, then it should be possible to explain thereby all the experiences as found in practice in connexion with juice-pressing.

Although I have not yet had sufficient practical experience to learn them all, I will treat those known to me. We may consider the following practical results of experience :—

(1) The best pressing results are obtained with the most regular feed (or blanket thickness).

(2) Setting up beyond a certain limit gives no better extraction results.

(3) Much reabsorption (or squirting) of a mill can be rectified by opening up.

(4) To stop heavy squirting (reabsorption) raising of the returner-bar will sometimes help. According to the previously mentioned theory, the returner-bar plate in that case must have been in such a position that the local irregularities of the bagasse fed into the back opening had become large. This will naturally always be the case when the returner-bar plate is placed too low, or so low that the compactness of the bagasse is insufficient to conduct the friction force caused by the top roller and required to make the bagasse slide over the bar. In this case the bagasse will begin to roll up, becomes more locally irregular, with the unavoidable consequence of an unreasonably large reabsorption. In such a case (when the returner-bar was placed too low), a lifting of the plate will stop this reabsorption to a large extent and increase the extraction.

(5) Grinding with heavy blankets and slow speed is better as far as extraction is concerned, than running a high speed and a thin blanket. And this for two reasons:—(*a*) A similar local irregularity is greater in proportion for a thin layer; because assuming a thin blanket of 3 grms. of fibre per c.c.. and a heavy blanket with 6 grms., and the irregularity of 0·5 grm., this makes for the thin blanket $\frac{1}{6}$, and for the heavy blanket $\frac{1}{12}$ of the thickness. It is clear the one $\frac{1}{6}$ layer thickness reaches a pressure equal to that of a normal layer at the narrowest opening more quickly than will be the case for one $\frac{1}{12}$ layer thickness. The influence of the reabsorption with thinner layers must therefore be greater (longer reabsorption tract). (*b*) Through the greater speed the juice pressure also becomes greater and the juice pressure line steeper. The case is now analogous to that in Fig. 2 where the lines I and II stand for slow running and Ia and IIa for fast running. Therefore an increase of reabsorption.

(6) The dry matter of the bagasse of the different mills increases towards the end of the mill train and the discharge openings decrease in the same direction. This can be explained by the fact that the local irregularities of the bagasse layer decrease towards the end on account of (*a*) the equalizing action of the mills, (*b*) the ever finer division of the bagasse. The finer the particles, the more locally regular a layer even to the eye. Due to the increase in local irregularities in the latter mills, the opening whereby the maximum pressure is reached becomes ever smaller in that direction (and consequently the smaller back opening), and thus the reabsorption must decrease in that direction (this explains the increase of dry matter in the bagasse). That actually this is controlled by the reabsorption follows from the fact that closing up the back opening, even if when this does not coincide with visible signs of reabsorption, causes no improvement in the dry matter of the bagasse, but only makes it harder on the engine. The foregoing also explains that:—

(7) The extraction increases as the cane passes more mills (due to the finer division of the bagasse). This increase in extraction is also helped along by the possibility of better maceration, although often in practice this increase is not always reflected in the figures, because as a rule more profit is expected from an extra mill in increased capacity. Thus the real influence of the reabsorption losses on the pressing cannot be checked in this case, but I am convinced that these are of influence.

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[1] See *Archief*, 1918, 145.

(8) Rollers constructed for better gripping do poorer pressing. This is easily to be explained by the reabsorption; because besides the local irregularities of the bagasse layer itself, the local irregularities of the rollers are bound to exert a similar influence and therefore increase the reabsorption. The rollers of the last mill, where the aim is to press as dry as possible, may therefore show no local irregularities.

(9) Preparatory apparatus exerts a beneficial influence. Here, too, I must bring in the reabsorption losses, because the better work here is due, not only to a possible better feeding of the first mill, but also to the finer division of the bagasse. From this it follows that any apparatus which accomplishes the finest division of the cane, must give the best results. This checks with the opinion of many on Hawaii, that an installation with a Searby shredder gives better results than a similar installation with a crusher. From my viewpoint the foregoing proves sufficiently the great influence of the reabsorption on the attainable pressing, and it stands to reason that we should try to encourage the factors which decrease the degree of reabsorption.

These factors are:—(1) The degree of local irregularity of the bagasse layer; (2) the degree of fineness of the bagasse; (3) the degree of local irregularity of the rollers; (4) the circumferential speed of the rollers; (5) the moisture content of the bagasse to be pressed. The degree of local irregularity of the bagasse layer is harmfully influenced by the difference in speed with which the bagasse leaves a mill, and that of the bagasse carrier which is to transport this bagasse to the next mill.

This may be cured to some extent by arrangements over the bagasse carrier, which causes the layer to become of equal thickness. The layer thus obtained appears regular to the eye and will be more regular locally as the bagasse is divided finer. Therefore this must be the aim. It is possible that an installation of crusher and Searby shredder may also prove to be the best for Java.

Retail Prices of Sugar in the United Kingdom, 1914 to 1922.

A question recently asked in the House of Commons, elicited the following figures from official quarters as to the trend of retail prices of sugar in the United Kingdom from July, 1914, to January, 1922:-

		d.		s.	d.
July, 1914	0	2	December, 1919, to March, 1920.	0	8
8th August, 1914	0	3¾	April and May, 1920	0	10
September, 1914	0	3½	June, 1920, to November, 1920 .	1	2
October, 1914	0	3¾	December, 1920	0	10
Nov., 1914, to Sept., 1915 ..	0	3½	January, 1921	0	9¾
Oct., 1915, to Jan., 1916	0	4	February, 1921	0	9
February, 1916	0	4¼	March, 1921..	0	8½
March, 1916	0	4½	April and May, 1921	0	8¼
April, 1916	0	4¾	June, 1921	0	7¾
May, 1916, to August, 1916....	0	5¼	July, 1921	0	7¼
September, 1916, to May, 1917..	0	5½	August and September, 1921 ..	0	7
June, 1917	0	5¾	October, 1921	0	6½
July, 1917, to April, 1918 ..	0	6	November and December, 1921..	0	5¾
May, 1918, to November, 1919.	0	7	January, 1922..	0	5¾

Plan of Work drawn up by the Java Experiment Station for 1922.

AGRICULTURAL SECTION.

Director : Mr. Ph. van Harreveld.

Analysis of samples of manures, soils, etc. ; examination of canes in connexion with diseases and injuries ; visits to estates for the investigation of cane diseases, soil, water, and other questions connected with cultivation ; laying out experimental plots on estates for the examination of the productivity of cane varieties, manuring questions, etc. ; meteorological observations ; statistical data on different varieties of cane ; examination of recently introduced fertilizers ; investigations on cane soils and their irrigation, on cane diseases and the maturing of the cane ; on cane selection ; comparison of the results obtained with appliances for the mechanical working of the soil, and similar practical questions.

TECHNICAL SECTION.

Director : Mr. F. W. Bolk.

Technical handbook ; improved methods of sampling and of the examination of the samples in connexion with milling control ; practical advice ; oil investigations ; studies on automatic installations ; tests with new cane preparatory apparatus ; and with isolating materials.

In 1922 the "new mutual control" will be applied as in 1922, having been found on the whole to answer all expectations. However, it is believed there is room for improvement in the determination of the weight of cane and juice, and in the analysis of the raw juice. Further, it is proposed to hold an enquiry into the reliability of the Adam apparatus, which recently has been modified.

CHEMICAL SECTION.

Director : Dr. W. D. Helderman.

Colloidal-chemical investigations of juices, syrups, molasses in connexion with clarification and the exhaustion of molasses. Regarding this subject, several publications have been issued during the past year[1] ; and from certain of them it would seem that the so-called combination theory of molasses formation must be abandoned, and that molasses must be regarded as a saturated sucrose solution.

Examination of the quality of Java sugar. Different samples of sugars have been collected from various factories, and analysed ; but the number of these samples is comparatively small. Publication of these results is therefore delayed until further data have been obtained.

Continuation of the investigations into the causes of unknown factory losses. Those already carried out at four factories have shown that the losses actually detected are almost always of a mechanical nature. Opportunity will be taken to apply a tell-tale apparatus which has been devised for the detection of entrainment losses.

Verification of methods of analysis. Visits to factories for the collection of data on practical questions connected with chemical control. Advice on chemical and technical questions. Publication of the figures relating to manufacture for the factories taking part in Mutual Control. Analysis of samples of sugar, fertilizers, etc. Standardization and testing of measuring flasks, weights, balances, polarimeters, etc. Meteorological observations.

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[1] *I.S.J.*, 1921, 509, 647, 684.

Chemical Control Results of Hawaiian Factories from 1912 to 1921.

(TRUE AVERAGES FOR THE LAST 10 SEASONS.)

	1912.	1913.	1914.	1915.	1916.	1917.	1918.	1919.	1920.	1921.
Cane—										
Polarization	14·34	14·05	13·78	13·77	13·45	13·76	12·97	13·74	13·64	13·12
Fibre, per cent.	12·67	12·85	12·74	12·51	12·74	12·62	12·50	12·49	12·64	12·80
Commercial Sugar per ton, in tons	7·99	8·14	8·13	7·98	8·16	8·03	8·51	7·94	8·12	8·61
Bagasse—										
Polarization	3·43	3·07	2·49	2·17	1·81	1·78	1·59	1·67	1·56	1·50
Moisture, per cent.	—	37·11	45·72	43·87	42·49	42·26	42·70	41·57	41·05	41·20
Fibre, per cent.	49·57	48·71	50·87	53·07	54·98	55·31	55·04	56·05	56·68	56·58
Pol. per 100 cane	0·88	0·81	0·62	0·51	0·42	0·41	0·36	0·37	0·35	0·34
Pol. per 100 pol. of cane	6·11	5·75	4·52	3·72	3·13	2·95	2·79	2·70	2·55	2·57
Pol. per 100 Fibre, "Milling Loss"	6·92	6·30	4·89	4·09	3·30	3·22	2·90	2·97	2·75	2·64
Weight per 100 cane	25·56	26·36	25·04	23·57	23·19	22·83	22·74	22·27	22·29	22·58
First Mill Juice—										
Brix	—	19·28	18·86	18·87	18·64	19·14	18·26	19·17	19·32	18·74
Polarization	—	17·17	16·73	16·65	16·34	16·85	15·92	16·74	16·85	16·16
Purity	—	89·02	88·71	88·24	87·70	88·02	87·18	87·34	87·24	86·22
$\frac{\text{Polarization of cane} \times 100}{\text{Polarization of first mill juice}}$	—	81·8	82·4	82·7	82·3	81·6	81·3	82·0	80·9	81·2
Mixed Juice—										
Brix	—	—	14·19	14·03	13·17	13·48	12·92	13·39	13·48	13·25
Polarization	12·79	12·49	12·16	11·89	11·14	11·45	10·85	11·29	11·31	10·97
Purity	—	—	85·70	84·75	84·59	84·88	83·99	84·29	83·87	82·77
Weight per 100 cane	105·23	103·07	108·14	111·44	116·99	116·53	116·05	118·29	117·35	116·50
Pol. per 100 cane	13·46	13·24	13·15	13·26	13·03	13·34	12·60	13·37	13·29	12·79
Pol. per 100 pol. of cane, "Extraction"	93·89	94·25	95·46	96·30	96·87	97·05	97·21	97·30	97·45	97·43
Extraction Ratio	0·48	0·45	0·36	0·30	0·25	0·23	0·22	0·22	0·20	0·20
Last Mill Juice—										
Polarization	—	—	2·28	1·96	1·75	1·71	1·56	1·70	1·65	1·68
Purity	—	—	74·96	73·88	71·71	71·15	69·52	68·53	68·20	65·89

CHEMICAL CONTROL RESULTS OF HAWAIIAN FACTORIES FROM 1912 TO 1921.—*Continued.*

	1912.	1913.	1914.	1915.	1916.	1917.	1918.	1919.	1920.	1921.
Maceration Water—										
Weight per 100 cane	30·79	32·42	33·64	35·04	39·85	39·39	38·99	40·80	39·95	39·30
Syrup—										
Brix	—	—	60·93	61·64	62·73	62·28	61·66	62·42	61·34	62·09
Purity	—	—	87·31	86·59	86·18	86·36	85·78	85·70	85·20	83·90
Increase in Purity	—	—	1·61	1·84	1·59	1·48	1·79	1·41	1·33	1·13
Press Cake—										
Polarization	—	1·99	1·76	1·81	1·82	1·52	1·48	1·34	1·65	1·66
Weight per 100 cane	—	1·72	1·78	1·89	2·20	2·28	2·36	2·32	2·63	2·58
Pol. per 100 cane	—	0·03	0·03	0·03	0·04	0·03	0·03	0·03	0·04	0·04
Pol. per 100 pol. of cane	—	0·24	0·23	0·25	0·30	0·25	0·26	0·22	0·31	0·33
Lime used—										
Total per 100 of cane	—	—	—	0·07	0·06	0·063	0·072	0·076	0·071	0·074
Commercial Sugar—										
Polarization	97·21	97·03	96·66	96·40	96·31	96·87	96·53	96·34	96·36	96·75
Moisture per cent.	—	—	0·93	0·98	1·06	0·87	0·94	0·96	0·97	0·92
Weight per 100 cane	12·51	12·29	12·30	12·52	12·25	12·45	11·75	12·59	12·32	11·62
Pol. per 100 cane	12·16	11·93	11·89	12·07	11·80	12·06	11·34	12·13	11·87	11·24
Pol. per 100 pol. of cane	85·66	84·95	86·56	87·65	87·98	87·93	87·91	88·57	87·35	85·86
Pol. per 100 pol. of juice	91·30	90·12	90·95	91·03	90·84	90·58	90·37	90·96	89·56	88·03
Final Molasses—										
Weight per 100 cane	—	—	2·80	2·81	2·90	3·07	3·04	3·02	3·24	3·63
Sucrose per 100 cane	—	—	0·99	0·97	0·98	1·07	1·04	1·00	1·10	1·22
Sucrose per 100 pol. of cane	—	—	7·12	6·98	7·41	7·68	7·96	7·24	8·03	9·27
Sucrose per 100 pol. of juice	—	—	7·43	7·22	7·64	7·89	8·17	7·42	8·24	9·51
Gravity solids	—	—	87·87	87·36	87·63	86·68	87·32	87·34	87·42	87·12
Gravity purity	—	—	40·40	39·69	39·25	40·03	39·07	37·95	38·75	38·53
True purity	—	—	—	—	—	—	—	—	—	—

Data relating to the Capacity of Sugar Factory Plant in Java.[1]

BY P. A. JANSZ.

There are only a few figures available in the existing literature regarding the capacities of the different stations of the sugar factory; and the tabulations which each year are sent in to the Experiment Station afford the opportunity for the collation of these data. Hereunder is given a resumé of the figures thus supplied, though some, owing to incompleteness, have been omitted.

The figures are expressed on a basis of a milling capacity of 1000 piculs of cane per day, the heating surface and filtering surface being expressed in square metres[2] and the contents in hectolitres.[3] Centrifugals sizes are calculated to the 30 in. machine, making use of the factors 1·8, 1·5, and 1·25 for the 48, 42, and 36 in. machines respectively.[4]

DEFECATION FACTORIES.

	AVERAGE.	MAXIMUM.	MINIMUM.
Raw juice heaters, sq. m.	15·0	28·0	3·0
Defecation tanks, sq. m.	1·8	6·3	0·4
First settling tanks, hl.	48·6	87·5	31·5
Second ,, ,, hl.	15·9	27·0	6·4
Filter-presses, sq. m.	20·0	32·0	12·0
Clarified juice-heaters, sq. m.	6·0	10·0	2·0
Evaporators, sq. m.	72·0	127·0	44·0
Syrup settling tanks, hl.	29·0	50·0	17·0
,, storage ,, hl.	18·0	34·0	4·0
Pans, capacity, hl.	46·9	73·3	32·2
,, heating surface, sq. m.	18·4	37·0	11·4
Crystallizers, hl.	101·0	145·0	57·0
First product centrifugals, sq. m.	0·75	1·14	0·41
Second ,, ,, sq. m.	0·72	1·00	0·45
Mixing trough, hl.	12·3	24·5	3·8
Pans for solidified molasses, capacity, hl.	10·6	16·7	5·0
,, ,, ,, heating surface, sq.m.	4·1	7·5	1·8

SULPHITATION FACTORIES.

	AVERAGE.	MAXIMUM.	MINIMUM.
Raw juice heaters, sq. m.	18·0	30·0	10·0
Defecation tanks, sq. m.	1·2	5·3	0·8
Raw juice sulphitation tanks, hl.	10·0	18·0	4·0
First settling tanks, hl.	50·5	80·0	18·4
Second ,, ,, hl.	18·7	26·3	10·0
Filter-presses, sq. m.	21·0	33·0	14·0
Clarified juice-heaters, sq. m.	6·0	10·0	2·0
Evaporators, sq. m.	80·0	125·0	60·0
Syrup settling tanks, hl.	31·0	52·0	12·0
,, coolers, sq. m.	2·6	3·8	1·2
,, sulphitation tanks, hl.	8·0	14·0	3·0
,, storage tanks, hl.	13·0	31·0	3·0
Vacuum pans, capacity, hl.	54·0	70·4	40·4
,, ,, heating surface, sq. m.	25·2	35·9	14·7
Crystallizers, hl.	106·0	174·0	65·0

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[1] *Archief*, 1922, 33-35.
[2] 1 sq. m. — 10·764 sq. ft.
[3] 1 hl. — 3·53 cub. ft.
[4] These are the ratios given by Q. A. D. EMMEN in his book "Rietsuikerfabrieken op Java en hunne Machinerieën," second edition, page 453.

Data relating to the Capacity of Sugar Factory Plant in Java.

SULPHITATION FACTORIES.—*Continued.*

	AVERAGE.	MAXIMUM.	MINIMUM.
Centrifugals, first sugar, foreworkers, sq. m.	0·58	0·91	0·38
,, ,, afterworkers, sq. m.	0·81	1·31	0·50
,, after-product, foreworkers, sq. m.	0·74	1·30	0·32
,, ,, afterworkers, sq. m.	0·40	0·70	0·25
Green syrup storage tanks, hl.	45·0	87·0	22·0
Clear syrup storage tanks, hl.	11·0	33·0	1·0
Mixing trough, hl.	10·0	22·0	2·0
Pans for solidified molasses, capacity, hl.	9·4	18·0	2·7
,, ,, ,, heating surface, sq.m.	3·8	6·8	1·2
Sulphur ovens, for raw juice, sq. m.	0·09	0·14	0·03
,, ,, for syrup juice, sq. m.	0·05	0·09	0·02

CARBONATATION FACTORIES.

	AVERAGE.	MAXIMUM.	MINIMUM.
First carbonatation tanks, sq. m.	22·9	38·5	12·5
Filter-presses, first filtration, sq. m.	21·0	33·0	13·0
Second carbonatation tanks, hl.	8·1	14·4	2·0
Filter-presses, second filtration, sq. m.	9·0	14·0	5·0
Clarified juice-heaters, sq. m.	6·6	12·0	3·0
Evaporators, sq. m.	87·0	131·0	60·0
Syrup sulphitation tanks, hl.	9·0	25·0	3·0
,, storage tanks, hl.	17·0	32·0	11·0
Pans, capacity, hl.	53·0	68·0	34·0
,, heating surface, sq. m.	22·0	29·0	13·0
Crystallizers, hl.	112·0	148·0	80·0
Centrifugals, first sugar, foreworkers, sq. m.	0·58	0·95	0·36
,, ,, afterworkers, sq. m.	0·90	1·24	0·47
,, after-product, foreworkers, sq. m.	0·64	1·00	0·33
,, ,, afterworkers, sq. m.	0·41	0·54	0·25
Green syrup storage tanks, hl.	37·0	56·0	25·0
Clear ,, ,, ,, hl.	10·0	20·0	2·0
Mixing troughs, hl.	12·0	16·0	7·0
Solidified molasses, pans for, capacity, hl.	7·5	11·5	3·0
,, ,, ,, heating surface, sq. m.	3·6	4·9	2·5
Lime kiln (cubic contents in c.m.)	4·0	4·0	4·0
Sulphur ovens, sq. m.	0 08	0·16	0·03

The difficulty of satisfying the farmers in the matter of prices for their beet crops is not confined to the United Kingdom. In Holland in 1921 the growers were not at all pleased with the prices obtained by their co-operative unions, nor are they satisfied with those offered for the 1922 crop by the other factories. At present it looks as though there would be a reduction this year in the beet sowings in Holland.

* * *

A Parliamentary Paper gives the following statistics showing the revenue collected in the United Kingdom from Customs duties on sugar imported, for the years shown :—

Year.	£	Year.	£
1819	3,511,178	1889-90	....
1829	4,454,200	1899-1900	....
1839	4,184,505	1909-10 & 1910-11 (mean)	2,837,000
1849	3,825,018	1917-18	14,939,000
1859-60	5,822,190	1918-19	26,890,000
1869-70	5,279,770	1919-20	40,654,000
1879-80	....	1920-21	28,968,000

It is clear that during the last four years the revenue obtained by the Exchequer from duties on sugar has been no small gain. It is one of the most widely diffused indirect taxes extant.

Recent Work in Cane Agriculture.

Annual Report of the Bureau of Sugar Experiment Stations, Queensland, to the end of October, 1921.

The Queensland sugar industry, after years of struggle against various difficulties, continues to improve. Mr. Easterby's Report for 1921 is as cheerful a document as that of the previous year.[1] The yield of sugar (including some 17,000 tons from New South Wales) promises to reach 295,000 tons which, taking the Commonwealth consumption as 285,000 tons, should leave a surplus. And there are indications that the latter figure will show some falling off, possibly because less Australian jam has been exported during the year. The enheartening effect of a fair price being paid to the mills for their sugar was referred to in this journal last month,[2] and this has reacted favourably on the character of the cultivation. The touring assistants inspected 2304 farms during the year, and report a considerable increase in the number using artificial manures. Their figures for last year and this are as follows:—Farms using lime, 160 and 230; employing green manuring, 398 and 460; applying fertilizers, 298 and 493. Freed from the wearing anxiety of making ends meet, the cane farmers are taking much greater interest in the improved methods of cultivation, constantly brought before them by the officers of the Sugar Bureau, and this is especially the case in the north where the main increase in the area cultivated has taken place.

The experimental work in Queensland is carried on under unusual difficulties, the chief of which are perhaps climatic, though it is not unaffected by labour troubles. A brief résumé of the distribution and conditions of the three stations was given in our remarks on the 1919 Report.[3] The following are the main results obtained during 1921.

Northern Experiment Station, South Johnstone.—The unsatisfactory nature of the site was mentioned last month.[4] The weather during the season was most abnormal, as will be seen from the falls of rain in inches each month from September, 1920, to August, 1921:—2·90, 3·30, 7·12, 6·62, 17·44, 22·40, 62·09, 18·04, 18·96, 12·67, 7·11, 4·92 = 183·57. The good early rains put the canes into a very advanced condition by March, when the enormous fall of over 62 inches fell, depressing the growth and, with the succeeding heavy winter rains of May, June and July, introduced abnormalities of growth and much rooting and shooting above ground, reduced the tonnage, and lowered the sucrose content of the juice. In spite of these untoward circumstances, however, the average yield on the farm was 41·29 tons of cane, as against 33·1 in the previous year. The following were the main lines of experiment:—(1) *Manurial experiments with N.G.15 and Badila* (first ratoons). The first place in the manures tried was taken by Holbourne Island phosphate. This is of high quality and contains 27·6 per cent. of phosphoric acid and much lime. The mineral phosphate was followed a long way behind by nitrate of soda, whereas the results with super, ammonium sulphate, and both combined, were practically negligible. The conclusion is tentatively drawn that at present artificial fertilizers may be "too soluble in the heavy rains of the tract to be of the greatest value." (2) *Different methods of ratooning* (*Badila*, first ratoons). These methods vary chiefly in the mode of dealing with the trash, as follows:—Canes volunteering through the trash, alternate spaces cleared and cultivated, trash burnt and cultivated with four furrows, the same with subsoiling each furrow, cultivation by disc harrow, and four harrows with a light dose of manurial mixture added. Of these six methods the last gave the best result, volunteering gave a better result than alternate cultivation, and disc harrowing than ploughing. The heavy rains are considered to have interfered with this experiment, which is to be continued to second ratoons. (3) *Value of subsoiling, with or without mixed fertilizer* (*Badila*, plant canes). Subsoiling is apparently uniformly advantageous at the Mackay Station, but the local farmers of the Innisfail district are not in favour of it, because of the heavy rains and porous nature of the soil. The results of the year's work were in accord with this opinion. (4) *Analytical tests of new canes* (from June to September). Forty-one varieties were included in this experiment, and these were analysed at 10, 11, 12, and 13 months when the crop was reaped. The results of these analyses are given in detail in a series of tables. Added is a list of canes arrowing during the year, with the dates of flowering; about 40 canes arrowed and seven did not. (5) *Experiments in raising seedlings.* This line of experiment was determined on for the reason that efforts to obtain seedlings, through a number of years, had proved unsuccessful at Mackay, and the Johnstone weather conditions were considered as likely to be more favourable. The methods employed were those of the Colonial Sugar Refinery, and the soil was obtained from the scrub and, after additional organic matter had been mixed, was sterilized by heat. Some 736 seedlings were obtained, and of these 260 were potted up. Twenty-two tons of cuttings of different varieties of cane were distributed during the year, but strikes (and the unsatisfactory location of the station) interfered with the visits of the planters and the distribution of seed cane.

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[1] *I.S.J.*, 1921, p. 199. [2] *I.S.J.*, 1922, p. 114. [3] *I.S.J.*, 1920, p. 223. [4] *I.S.J.*, 1922, p. 115.

Central Experiment Station, Mackay.—Taking the year through, the rainfall was generally favourable and much better than the previous season. Abnormally heavy falls in March checked growth, and a number of stools were blown down; there was no very cold weather in winter, but at the end of June (beginning of July ?) a heavy fall of rain, with strong winds, again brought a number of canes down. The monthly rainfall was from 1 to 3 inches for most of the year, increasing to 6·97 in July and, in January to March, to 12·70, 16·41, 26·31, with the respectable total of 78·17 inches for the year. The experiments with the best 15 of Wells' New Guinea collection were continued as second ratoons and, as before, there was nothing among them to equal *Badila*. Subsoiling experiments were also continued, and again gave results in favour of this operation on the alluvial soil, with heavy clay underneath, of the station. A comparative test of the effect of potassium sulphate and chloride on the juice resulted in clearing the latter from the suspicion of any deleterious action, but the experiment will be continued on to ratoons as usual. Of the exotic varieties tested, the following eight from Java and Hawaii "appear to be quite a good class of cane as to growth and juice analysis, and will doubtless improve on acclimatization":—*E.K. 1*, *E.K. 2*, *E.K. 28*, *J. 247*, *J. 100 Bont*, *H. 109*, *H. 146*, and *H. 207*. The distribution of free canes was much below that in the two previous years, probably owing to the growers having good Queensland seedlings and also to the small number of varieties offered. The average yield of canes on the station was 32 tons.

Southern Experiment Station, Bundaberg.—As many as nine different lines of experiments were conducted; but Mr. Easterby again gives voice to his disappointment at the results at Bundaberg, which, owing to frosts and droughts continually upsetting the balance, are not nearly so satisfactory as in the more consistent weather conditions of the two other farms. The results of growing canes on red land which had been under alfalfa for a series of years again showed no ill effects on the crop. No appreciable differences were obtained in the application of burnt lime and ground limestone, while the latter in quantities varying from one to six tons per acre also gave no indication that lime was a useful addition. Subsoiling was of no benefit, probably owing to the open character of the soil. The weather was comparatively mild, only a few light frosts occurring, which did very little damage even in low-lying places, and the rainfall of 45 ins. was fairly evenly distributed. About 16 tons of canes were distributed free, and a like quantity sold to farmers, the favourites being *Q. 813* and *D. 1135*. The average yield of canes on the station was 23·7 tons.

REPORT ON THE DEPARTMENT OF AGRICULTURE, BARBADOS, 1920-21.

This Report, which has been much abbreviated owing to expense and the usual delay in issue, contains information as to the pests and diseases in the cane fields during the year. *Insect pests.*—*Sipha flava*, an aphis hitherto unrecorded, was found along the outskirts of the area infected by the Mosaic disease. This is considered of importance because it has been "more or less conclusively proved to be able to spread the disease and may render control more difficult." *Root-borer* and *Hard back* were still as prevalent and caused as much damage as in the previous year, but there are as yet no signs of co-operation among the planters regarding measures for their control. Observations made with hard back (six cases) captured in copulation last year gave an average number of 108 eggs for each female, 1·6 being laid per day during the egg-laying season. To confirm this observation, a female and four males, raised from eggs, were confined in a cage and detailed countings of the eggs laid were made. The female laid 113 eggs, and when she died had 32 more inside her in various stages of maturity. The eggs were laid at the rate of 1·4 per day. *Moth-borer* was still causing loss where selection of seed had not been attended to, and no effort was made at encouraging natural enemies such as *Trichogramma minutum*. *Scale insects :* Pseudococcus and Aspidiotus did appreciable damage owing to the drought. The *Cane-fly* (Stenocranus) was not observed and its parasite (Anagrus) is apparently holding it in check.

Fungus attacks.—*Root disease* continued to be serious and was especially evident during the season because of the drought. Mr. BOURNE several times isolated Rhizoctonia from affected plants, and considers that this fungus is for the most part responsible for the disease. The doubt as to Marasmius being the sole cause appears to be gaining ground and "until greater certainty is reached" planters are advised to "plant only healthy canes and pay special attention to drainage and tillage." *Colletotrichum falcatum* and *Cephalosporium sacchari* associated with red rot, *Thielaviopsis paradoxa* causing the pine-apple disease, *Cercospora vaginae* causing red spot on the leaf sheath, and *Leptosphaeria sacchari* the cause of the ring spot on the leaves have been observed in various parts of the cane area to about the same extent as in the previous year. The average rainfall on the island was 42·09 in., or 20 less than the average for 60 years which is 62·08.

REPORT ON SUGAR CANE EXPERIMENTS, BARBADOS, 1919-21.

Reference was made last year[1] to the enormous bulk to which this Annual Report had attained, and very considerable changes appear to have been made in it. Instead of 77 large pages, closely printed where filled, there are only 37 this year. This, it is explained, is due to the delay which has occurred in recent years in the appearance of the Report; and, consequently, it has been decided to delete from Part III the 35 tables containing the results obtained on the various estates with the different varieties of cane, manuscript copies of these being sent to the managers. Part II, dealing with manurial experiments, has been increased by the inclusion of three tables, giving the results of experiments with "nitrapo" and other manures, made on behalf of the Chilean Nitrate Committee, and one giving the effects of soaking the sets in various compounds before sowing. Against this increase, on the other hand, Part III dealing with varieties of sugar cane has been further shortened by the exclusion of the last six tables, although we have not met with any explanation of this omission. The tables referred to give summaries of the analyses, of seedlings grown for three seasons on black soils for last two, and of some of the better seedlings and varieties also on black soils that have been under experiment for five years; the tonnage of varieties grown on red soils, for the season, plant canes, first and second ratoons, and of those grown on red soils for four years as plants and first ratoons; and, for Scotland district, the mean tonnage of seedlings and varieties during the season as plants, first and second ratoons, and of some of the better ones under experiment for the past five years.

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[1] *I.S.J.*, 1921, p. 336.

The Report offers some difficulties to the general reader by its mode of presentation. Whole paragraphs are reprinted bodily from previous years without the alteration of a single word, and it is impossible to decide what is new without having the previous reports at hand. The paragraphs are extremely long and closely printed (one of them has about 1000 words), and are charged with numerals and names, greatly increasing the labour of perusal. Many of the experiments suffered because of the drought, and as was the case last year, were so severely attacked by root-borer and hard back that it was not possible to draw any useful conclusions from them. Table VI shows a great reduction in the numbers of grubs collected in the manurial plots during recent years. This is put down to the continued destruction of those taken out each year. Thus, in Summervale field, the insects collected were 8227 in 1915-17, 7629 in 1917-19 and only 2993 in 1919-21. This is good reading. But the explanation given appears to be somewhat discounted by the figures published last year of the insects collected at Lower Bay Tree field, where the experiments appear to be conducted alternately with Summervale and the same procedure is adopted. The figures given in last year's report of insects collected, were 2305 in 1914-16, 5962 in 1916-18 and as many as 7577 in 1918-20. The effect of the constant destruction of the pests in Lower Bay Tree field seems not to bear out the claim that this action alone is responsible for the diminution in Summervale.

ANNUAL REPORT OF THE DEPARTMENT OF AGRICULTURE, JAMAICA, 1920.

Some attention is given to sugar cane in this Report. The prevailing drought (27·6 ins. less than the average of 40 years) affected the industry here as elsewhere in the West Indies and, in spite of large increases in cultivation and factory capacity, the yield was only 37,000 tons of sugar. This was, however, countered by the extremely high prices obtained: the sugar brought in some £3,000,000 and the rum as much as £290,000. It is confidently expected that Jamaica will in the near future be able to maintain a regular output of 60,000 tons of sugar. Experimental work on the crop appears to be set about in earnest; but it is unfortunate that, just at this juncture, the Department has lost its Assistant Director of Agriculture, Deputy Island Chemist and Microbiologist in a few months. "Thus" Mr. COUSINS, the Director, writes "almost at one blow, the Department has been deprived of three of its technical scientific officers and, to date, there appears to be no immediate prospect of their being replaced by new officers."

Manurial plots.—A series of these has been arranged for testing the effect of nitrate of soda, sulphate of ammonia and sulphate of potash in various combinations (these three have been found in the past to give good results in Jamaica), lime at the rate of 10 tons and cattle manure at 30 loads per acre, and a quart of ashes per clump. These are arranged so that each of them is next to a no manure plot. Phosphatic manures are entirely omitted from the series as no advantage has been obtained from its use after years of experiment.

Varietal tests are to be resumed, as these have apparently been allowed to lapse in recent years. The *Uba* cane appears to be rapidly assuming an important position in the dry area of Vere and on the north coast, and in places blocks of 100 acres are to be met with. The first recorded tests give, for Gales Valley, 31 tons of *Uba* cane against 22 tons of estate canes, and for Hampden (where drought was severe) 12 against 7; at Worthy Park, however, *Uba* only gave 26 tons against 35 and had 20 per cent. less juice and that of an inferior quality. This variety is looked upon as likely to assist in solving the difficult fuel problem, and should be a useful stand-by in poor years, though it is recognised as less convenient for reaping because of the large number of thin canes and the tightly clinging trash. Nurseries for raising seedlings have also been started in three places. The Plant breeder, on reaching the island and taking charge, found all the varieties on the Station attacked by Mosaic, excepting *P.O.J. 100* and *Uba*. After drastic roguing and replacement by immune varieties, he considers that the plots are practically freed from this disease, but great gaps are to be seen on account of the drought. *Saccharum ciliare* has been introduced from India by seed and two plants are living, although the purpose of this importation is not mentioned. It is not likely to be of use for crossing, as this has we believe not yet been found possible, nor would it be a desirable parent because it does not form cane.

The Entomologist, arriving from Uganda, found no records or collections, "except a few damaged and unnamed insects," but has set about remedying this defect with great energy. The Microbiologist reports, regarding Mosaic, that its distribution is rather indefinite, but causes a serious loss of tonnage in all varieties attacked. Transparent resist it better than Ribbon canes and *B. 208* and *B. 3922* are severely attacked. He considers that ordinary roguing should be sufficient for its control and suggests that each large estate should put down a limited area of immune or highly resistant varieties for use in case of emergency. It is to be hoped that the untoward depletion of officers will be only temporary and that it will be possible for these experiments on sugar cane, which are so badly needed in the island, to be carried through.

C. A. B.

In addition to the methylated spirit which they manufacture, the Colonial Sugar Refining Co., Ltd., of Sydney, have put on the market in Australia an alcohol motor fuel, the price of which is stated to be 3s. 3d. per gall. retail in tins, as compared with 4s. for petrol. It is said that one million gallons of this spirit will be available this year, and that if it finds favour with the public, arrangements will be made to increase the production and lower the price.

The American Sugar Refining Company, which has for some time been selling sugar direct to retailers in the New York District, has recently decided to abandon this policy and in future only wholesalers will be supplied. Accordingly, about 11,000 retail accounts will be transferred. This company is a strong believer in advertising its brands of sugar, and in conjunction with the Franklin Sugar Refining Co., opened in February a 12-weeks' advertising campaign in 879 Eastern American papers, featuring Domino cane sugar and Domino syrup.

Separation of Bagacillo, etc., from Cane Juice after Liming, using the Carter Automatic Strainer.

Some particulars have already been given of the Carter Juice Strainer,[1] which has had a considerable success in Cuba and elsewhere for the separation of the *bagacillo* and other solid impurities from cane juice in a continuous and efficient manner.

Hitherto this apparatus appears to have been largely used for the defecated juice, that is, juice which has been limed and heated. It should, however, be understood that results as least equally satisfactory can be obtained when the juice is limed in the cold, passed through the strainer, and afterwards heated. This, in fact, is regarded by many as an advantageous procedure, in that the *bagacillo* containing the colouring matter saccharetin is separated before it can have a chance of being acted upon and partially rendered soluble by the hot alkaline liquid.

Some experiments have been carried out by the West India Sugar Finance Corporation at their Central Consuelo, Dominican Republic, in straining the limed cold juice by means of the Carter apparatus. Since 1916, this factory had been using a Carter Strainer on the hot defecated juice; but last season arrangements were made to strain the limed cold juice, and 100,000 bags of sugar were made with highly successful results.

The common receiving tank from the scales was used as the supply for the strainer which was situated on the same floor as the juice heaters. The juice flowed by gravity from the supply tank 8 ft. 5 in. above the inlet nozzle on the strainer, driving the machine at 40 revs. per min. The strained juice was discharged into the juice-heater supply tank situated directly beneath the strainer, from which it was pumped through the heaters.

The suspended matter removed from the juice flowed by gravity through the mud pipe at the bottom of the strainer to the mud canal under the defecators, with the volume of a 1 in. pipe of juice escaping with it. The small volume of unstrained juice passed over the screen surfaces and kept them clean, at the same time conveying the separated matter wherever desired. With this arrangement the *bagacillo* passing through the mill strainer was prevented from being heated, or passing into the defecators or evaporators.

It may be claimed that this *bagacillo* is needed at the filter-presses as a filtering medium, but to what degree of fineness it may be used to advantage is a question. It would appear that this separated matter should be returned to the mills from the cold strainer and not to the *cachaza* or mud, thus avoiding the evil results of heating the suspended matter.

The ordinary mill juice strainer had a 12 mesh brass punched plate, with 144 holes per sq. in.; size of opening, 0·053 in.; while the Carter Strainer had three sets of twilled monel metal wire cloth as follows:—

	No. Mesh.	Holes, per sq. in.	Size Opening.
First Strainer	20	400	0·0220 in.
Second ,, ...	30	900	0·0163 ,,
Third ,, ...	40	1600	0·0115 ,,

Upwards of 17,000 lbs. of *bagacillo* were removed from the cold juice each 24 hours from the juice of 240 tons of cane.

During these experiments on straining cold juice, a Carter apparatus was operating at the same time on the hot defecated juice. Since installing the cold juice apparatus the amount of *bagacillo* separated by the hot juice apparatus has decreased from 2500 lbs. to less than 500 lbs. in 24 hours.

The percentage of mud from the defecators has decreased; much more clear juice is recovered, and the juice settles more readily. The general clarification is improved and the heaters, defecators and evaporators are free from the scale and deposits of former years. The department can handle more juice than in former times.

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[1] *I.S.J.*, 1920, 715; 1921, 405.

American Commerce Reports.[1]

ALCOHOL AS A MOTOR FUEL IN CUBA.

Experiments with alcohol as a fuel for automobile and other gasoline engines have been carried on for some years with encouraging results by distillers and others, but until recently the product was not offered to the trade in active competition with gasoline. Public interest in the substitution of a national for an imported product is aroused, and a large number of the automobiles now operating in Havana are using alcohol as their motive power.

The slowness with which alcohol has won acceptance as a fuel for gasoline engines in Cuba is partly explained by the rules for denaturizing which were in force up to July 2nd, 1921. In order to protect the revenue derived from alcohol utilizable as a beverage, the Government required the addition to alcohol intended for fuel of certain denaturizing elements which, when the alcohol was burned, produced a deposit of naphthalene To eliminate this difficulty, a decree was issued prescribing a formula for denaturizing alcohol testing 95 rectified degrees (grados rectificados) intended for fuel purposes.

Manufacturers claim that for use in Cuba the addition of gasoline prescribed in the formula is unnecessary, since under the temperatures prevailing in the island, alcohol vaporizes satisfactorily without it. The trade, however, favoured the addition of gasoline to make doubly sure that vaporizing would be satisfactory and that no dissatisfaction on this point could arise among those who tried out the new fuel. The colouring, another constituent, is intended to allow alcohol denaturized according to the formula to be easily distinguished from that otherwise modified for industrial uses.

A large number of distillers in various parts of the island are now manufacturing alcohol suitable for use in automobiles. Because of the very recent development of this phase of the distilling industry no official statistics are available. Statistics collected from private sources by a company which is stated to be producing slightly more than half of the total current output indicate that during the month of August the production was between 13,000 and 14,000 gallons per day. Production is now equivalent to sale, and manufacturers could easily double their daily yield if the market would consume the product.

As yet, only the lower grades of the molasses by-products are used in manufacturing motor spirit. About 2½ gallons of molasses are required for producing 1 gallon of the fuel. Manufacturers believe that with improvement in methods of production it may be profitable to manufacture alcohol from the bagasse, which is now largely consumed directly in the furnaces of the sugar mills.

Cost of Production.—The distillers claim they will ultimately be able to produce at a cost below that at present. Freight rates are still high, and thus increase the cost of assembling the raw material and of delivering that portion of the product which must be shipped by rail. The manufacturers earlier in the year generally provided for their season's supply of molasses at a price far above its present level of about 2 cents per gallon.

The representative of one of the largest producers of motor spirit states that with molasses at its present level his company can produce motor spirit to be sold at 20 cents per gallon.

Comparison with Gasoline.—Though the consumption of motor spirit has increased rapidly since July last, it cannot be said that its value compared to gasoline as a fuel is yet a matter of common agreement in this market. The manufacturers claim that alcohol modified as required by the decree cited gives, when used in automobiles, mileage equal to that attained with gasoline. Preliminary experiments by a public service corporation in Habana with machines specially adjusted for alcohol seem to confirm these claims, and similar reports are made by a number of the larger automobile agencies. Other users, among them some who are very anxious to see alcohol develop as a motor fuel, have not had such favourable results and insist that no definite statement can yet be made concerning the best method for adapting alcohol for use in automobiles nor as to its mileage cost compared to gasoline.

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[1] Culled from "Commerce Reports," published by the Department of Commerce, Washington. In many cases these are abbreviated here.

It is generally accepted that much better operating results are obtained when alcohol is modified by the addition of certain other substances, especially ones which furnish a certain amount of lubrication and eliminate the tendency to rusting which appears when alcohol is used alone. The adjustment of the motor for the modified " motor spirit " also has an important effect on the efficiency obtained. The changes which have been found necessary are simple and vary with the makes of machines. In some, the adjustment of the needle valve in the carburetter is necessary. In carburetters which do not have needle-valve adjustment it is necessary to bore a larger hole in the jet feeding the alcohol. Cork floats must be coated with wax to make them impermeable to alcohol or must be replaced by metal floats. The deposit of carbon in the engine when motor spirit is used is reported to be much less than with gasoline fuel.

Prices and Prospects.—The current price for motor spirit as sold on the street to the consumer is 27 to 30 cents. This compares with a current retail price of gasoline of about 45 cents. Alcohol manufacturers declare that this lower price for motor spirit represents not a difference in efficiency of the fuel, but a rebate they make to overcome the conservatism of the public that makes automobilists slow to take up its use.

Alcohol fuel has certain distinct advantages in the Cuban market. It is a national product made from materials which, in many seasons, sell at very low prices. Its use, therefore, appeals to local patriotism. In addition the high tariff on imported gasoline ($4·70 per 100 kilos) gives the alcohol manufacturer a decided advantage over the foreign gasoline importer, but not over the enterprises manufacturing gasoline on the island. It does not appear probable, however, unless manufacturing costs and the supply of raw materials are greatly changed, that Cuban alcohol can give serious competition to gasoline outside the island, even if experience should prove the claims of Cuban manufacturers as to its merits to be well grounded.

Within the island itself the position of motor spirit is still uncertain, quite apart from its mileage value compared to gasoline, for though the production since July 2nd last has shown rapid increase, there are many factors in the cost of production under normal conditions which cannot be estimated. In addition, the price basis on which gasoline can be sold locally, if motor spirit should threaten to become an active competitor, is still undetermined. Manufacturers do not consider practical the proposals which have recently been made in Cuba to turn the low-price sugars into motor spirit. One of the largest producers states that sugar would have to be sold at about 1 per cent. a lb. to allow the retail sale of motor spirit made therefrom in competition with gasoline at a retail price of 23 cents per gallon.

BRITISH AND FRENCH SUGAR IMPORT REQUIREMENTS.

Careful estimates drawn from reliable trade sources give the sugar consumption of the United Kingdom for 1922 as 1,500,000 tons, as against 1,420,000 tons in 1921, and a pre-war consumption of 1,900,000 tons. It is expected that the 1922 figure will be larger in case sugar gets the benefit of a lighter duty under the anticipated reduction in British taxation in the next budget estimates. British refineries should melt about 1,100,000 tons this year, leaving about 400,000 tons of refined sugar to be imported, the bulk of which must be drawn from American sources. The refineries of the United Kingdom will be mainly dependent upon Cuba for the rest of the supply, as only small quantities can be procured from the British West Indies, the Dominican Republic, Brazil, and Peru. Crops of Java and Mauritius are not being relied upon, as they are using white sugar for local consumption and for distribution in the Far East. The feeling prevails that low-priced sugar is a disaster to all producers and can not be expected to last much longer. Purchases in January were stimulated, amounting to 700,000 tons of raw sugar and 30,000 tons of refined; of the latter, 13,000 tons came from Czechoslovakia, but the exporting power of that country for the present year is reported as nearly exhausted.

In the case of France, five or six years must elapse before the country becomes self-supporting, as before the war. Production this year is scarcely half the consumption, which is rising but is not yet back to the pre-war figure. Not less than 250,000 tons must be imported from now to next October. It is expected that about 200,000 tons of this will be drawn from American sources. The amount of American refined sugar purchased will depend upon the prices and terms of sale. The demand for irrevocable credits established before goods are loaded is not liked by the buyers, who would appreciate 30 days' credit dating from issue of bill of lading. Sales of refined sugar might be further increased by sales of 400, 500, or even 100 ton lots on consignment, to be distributed by duly qualified agents to French buyers who operate on a small scale and have not the cash necessary to import large quantities direct. Outside the large refineries, few firms are in a position to import American sugar on a broad scale. A large amount of the purchases for French account is handled as a rule through London brokers.

TRACTORS USED IN CUBA FOR SUGAR CULTIVATION.

Tractors used in Cuba are employed mostly in connexion with the production of sugar cane. Most of the companies selling them are represented by the chief machinery houses or by general importing and exporting houses. Only one manufacturer has a representative in Cuba who devotes himself exclusively to selling the company's products and equipment for such products. Several American firms have given their representation to local companies, which have bought a few machines but have not had the facilities for properly advertising the goods, the mechanics to instruct buyers in their use, nor the spare parts to repair breakage quickly. Such representations have failed, with prejudice to machines which under other circumstances should have had success.

All the manufacturers prominently represented are Americans. A few French, German, and British lines (two French tractors and one of each of the others) were imported shortly before the economic crisis, but no serious competition with American manufacturers developed, and since the crisis sales by all companies have been at a very low ebb During the first 11 months of 1921, only 12 farm tractors, valued at $24,951, were exported to Cuba from the United States. Opinions differ as to the possibility of competition from Europe in normal times. The criticisms of European machines are as a rule that they are not fitted to Cuban conditions of work or are too expensive. On large plantations results have been obtained with the English Fowler steam plough. The difference in tariff rates is not considered to be a serious hindrance to the sale of European tractors.

Very few sales of tractors are being made at the present time and a renewal of sales in this, as in all other lines of trade, will be determined by the return of prosperity to the sugar industry.

Very little new planting of cane is being done at present, and therefore slower methods of preparing the soil are not a disadvantage. In addition, oxen and manual labour are now very cheap. Many who had bought tractors are anxious to sell them second-hand and practically all the large dealers are already heavily stocked with hold-over machines. These circumstances will delay the purchase of tractors abroad even after purchases in Cuba begin to pick up There are some representatives of tractor manufacturers who are frankly doubtful whether the tractor has yet proved itself under normal Cuban conditions. If quick results were needed in cane growing there would probably be a steady market when the sugar industry again becomes prosperous. But quick results have not been essential except under war conditions. Virgin lands are available for extension of cane plantings and these are often merely burned over and planted without any ploughing.

Further, while a well-cared-for tractor could complete with oxen and manual labour in unit cost even before the war, the actual performance of tractors is limited greatly by carelessness in the handling of the machines. Generally the Cuban operator is lacking in knowledge of the proper methods of handling and caring for the tractor which he operates. Workmen have almost no mechanical training and some tractor users have found it necessary to import mechanics from the United States at high wages. Occasionally prejudice against the new methods introduced by tractors runs so high that workmen create difficulties for the operators and in some instances have even attempted to bribe demonstrators to do poor work.

Both wheel and tracklaying types of tractors are used successfully in Cuba, the number of wheel tractors in use far outnumbering those of the tracklaying type. For heavy work the latter is preferable, and for light work both types operate satisfactorily. Wheel tractors of 10-20 to 15-30 H.P. are most generally used. Disc-ploughing equipment is employed, except when the machines are for use in the lighter soils of the Isle of Pines. Disc equipment for the lighter machines is two or three discs, of 24 ins. diam. Few harrows are sold, but when the work of disc harrows is actually demonstrated, it is appreciated. [Report of Commercial Attaché, Havana, Dec. 1921].

DOMINICAN REPUBLIC..

The year 1920 brought unprecedented prosperity to the Dominican sugar industry. The crop was the largest on record, totalling 177,736 tons, as against 166,680 tons in the previous year, while the average sales price of $12·65 per cwt. was more than double the price of $5·98 realized on the 1919 crop, and quadruple that received for any of the pre-war years. The total of 1,091,775 bags (320 lbs. each), which were shipped out during the season, was valued at $45,739,878 representing in value 78 per cent. of all Dominican exports.

The Formosan Sugar Crop, 1921-22.

A report to the Department of Overseas Trade from the Acting British Consul at Tamsui, Formosa, states that the second official forecast of the Formosan sugar crop for the season 1921-1922 has just been published, according to which the area under cane and the anticipated production of each of the principal sugar companies is as follows:—

COMPANY.	AREA. ACRES.	PRODUCTION. PICULS.
Teikoku Sugar Co.	262,400	570,364
Shinchiku ,, (Byoritsu)	2,734	42,459
Taiwan ,,	80,760	1,252,385
Toyo ,,	46,877	867,581
Meiji ,,	45,892	803,436
Dai Nihon ,,	30,988	523,973
Rin Honhen ,,	10,038	148,020
Ensuiko ,,	39,835	601,380
Niitaka ,,	20,833	490,143
Tainan ,,	10,471	121,014
Shinko ,,	4,600	78,392
Sharoku ,,	2,940	42,443
Taito ,,	3,037	23,149
Total	561,415	5,564,739

The above estimates are furnished by the various companies, and on the average taken for the past four years the actual quantity of cane crushed has worked out at about 93 per cent. of the quantity estimated as available at the time of the second forecast.

Taking this basis, therefore, the Sugar Bureau of the Formosan Government consider that the actual amount of cane crushed should be 54,547,717 piculs [3,246,800 long tons], and the production of centrifugals 5,171,123 piculs [307,797 long tons], the average yield of sugar being 9·48 per cent. of the quantity of cane crushed. The production of brown sugars is estimated at 240,000 piculs [14,285 long tons].

In the season 1920-1921 the actual production of sugar was 4,018,600 piculs of centrifugals and 194,600 piculs of brown sugars. The season now opening is therefore expected to show much better results than the last, this being mainly due to the fact that the island has this year been singularly free from typhoons and storms.

Correspondence.

ARE CANE PESTS INEVITABLE?

To the Editor, "The International Sugar Journal."

Sir—To those who were engaged in Sugar Estates thirty-five or forty years ago, the present position of canefields in a great many of the older cane sugar producing countries as regards insect and fungoid pests, as compared with what it was then, must afford food for much thought.

In and prior to those days the canefields were comparatively free from these disabilities. Indeed with the sugar-making appliances which then obtained, it would have been a difficult matter to work up the canes in the damaged condition they frequently now are from these causes.

When the Bourbon cane in the West Indies, after about a hundred years of healthy growth, became subject to disease and to the attacks of insect pests to such an extent as practically to cause its abandonment, it was thought that this was due to that particular cane being "played out," its condition leading to its becoming the happy hunting ground for pests, thereby leading to their multiplication in connexion with it. This may have been so, but have the pests of the sugar cane abated in virulence or diminished in number with the varieties which have replaced the Bourbon in the last thirty years? Are the cane pests of Java and Mauritius less numerous with the present canes than they were with the varieties which preceded them?

The reply to these queries is to be found in Deerr's recent work, in which an appalling number of cane pests, enough to make the heart of the prospective planter quail, are enumerated.

I take it that the healthier a plant is the less encouragement it gives to insect and other pests to attack it, with the consequent comparative freedom of the particular area of cultivation from them; and that, conversely, unhealthy plants lead to their increase both in virulence and number. This being so, appearances point very much to there being something wrong with the present system or systems of cane production which in the older soils lead to unhealthy canes. This is borne out by the fact that, although we hear on all sides of improved extraction in the factories, when it comes to the question of the amount of sugar obtained per acre, improvement on the old returns is not noticeable.

Have cane growers ceased to be skilful farmers, or have they been forced into a system or systems of cultivation contrary to the practice of the true principles of agriculture by the development of the central factory system, by the constant economic upheavals to which sugar markets are liable, or by the necessity for the growing of cheap (?) canes in order to compete in cost of production with new cane growing areas?

I am aware that in all branches of agriculture new varieties have in course of time to be substituted for old; but in the case of the sugar cane this has not, as it surely should have done, led to pests being kept under by the natural process of immunity.

There are doubtless among the readers of the *International Sugar Journal* planters still alive who were acquainted with the old conditions of cultivation, whose views on this subject would be valuable, inasmuch as it would place the present generation of sugar cane growers and scientists in possession of facts of which otherwise they would not be aware.

Faithfully yours,

FREDERIC I. SCARD.

Publications Received.

Instructions pour Laboratoires de Sucrerie. R. Gillet. (Imprimerie F. van Buggenhoudt, 5 & 7, Rue de Marteau, Brussels.) 1921. Price: 30 francs.

This book by Mr. RENÉ GILLET (a well-known Belgian chemist, who is advisor to the Sucreries et Raffinerie de Pontelongo, Padua, Italy) deals with methods of general analysis and sampling; the analysis of sugar factory and refinery products; the calculation of the chemical control results; and the analysis of materials which are used in manufacture and refining (such as fuels, oils, limestone and lime, animal charcoal, ultramarine blue, etc.): while in addition a number of specimen sheets and certificates for the statement of the figures obtained are presented. On the whole Mr. GILLET has covered this ground well. Especially has he borne in mind the requirements of the young chemist, as well as those of his more experienced colleague, there being throughout plenty of detail in the instructions given. This is particularly apparent in the section dealing with saccharimetry, in which the reader is supplied with useful information much of which is not to be found in works dealing with the optical determination of sucrose. Furthermore, a number of sketches are reproduced for the illustration of the more important apparatus used in the laboratory.

Regarding the methods of analysis followed, in general these do not call for much comment, as the author stands on safe ground by having adopted almost everywhere processes that have been approved. One may remark that as an alternative to the Herzfeld double polarization method of determining sucrose in molasses, Mr. GILLET recommends Pellet's process of taking both the direct and inversion readings in the presence of sulphur dioxide,[1] which we believe to be a convenient and reliable procedure, one which should be more generally adopted for both beet and cane products. In determining reducing sugars, the volumetric permanganate method, as modified by Mr. GILLET himself, is given; while for obtaining more exact results the Possoz-Pellet gravimetric method,[2] in which reduction carried out at 63–65° C., instead of at boiling point (in order to avoid reduction by sucrose) is recommended. Coming to the section on chemical control calculations, a serviceable summary is given of the method of computing the results obtained in the laboratory, in order to arrive at an estimate of the efficiency of working. One notes that the sucrose entering into process is calculated from the weight and analysis of the fresh slices without making any deduction for the wash-water that may have adhered to the roots; that the quantity of carbonatation scums per 100 of roots is found by multiplying the lime used by a factor varying from 4·0 to 4·2; and that the weight of massecuite is ascertained from the volume and density of the material when in the crystallizers.

Originally, we understand, Mr. GILLET compiled his "Instructions" for the use only of his assistants; but we are glad that he has decided to make them available (after some elaboration) to his colleagues of the sugar world. We hope that his book will be well appreciated, as it deserves to be, and that it will come to be regarded as a valuable practical guide for the beet factory and refinery chemist.

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Handleiding ten Dienste der Molencontrôle. [Manual used in Milling Control.] Bulletin No. 3. (Proefstation voor de Java-Suikerindustrie, Technische Afdeeling, Semarang.) 1921.

While Bulletin No. 11 of the Java Sugar Experiment Station (reviewed last month[3]) deals with the laboratory methods to be followed in effecting the chemical control of the factory as a whole according to the mutual control system of that country, this Bulletin No. 3 is devoted specially to milling. It is divided into four parts: the first treating of the weighing or measuring of cane or juice, the standardization of apparatus employed for this purpose, and the methods of sampling and analysing bagasse and juices; the second with the deduction of the formulæ for the calculation of the results according to the new system of milling control, stating the results separately for each unit, whichever method of maceration may have been adopted; the third with certain considerations in milling, such as power consumption, hydraulic pressure, openings, capacity, and volume worked; and the fourth consisting of an appendix comprising illustrations of systems of weighing juice and water under varying conditions of applying the maceration liquid, suitable arrangements of piping for applying maceration, mechanical apparatus for the continuous sampling of juices, various tables and model control sheets, and lastly drawings of different types of mill grooves and rollers (including the "Excelsior," "Raalte," "Best-rol," "Raggled," "Diamond," "Nobby," "Halle," "Werkspoor," "Industrie" and "Palaez" types).

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[1] *I.S.J.*, 1912, 332, 624; 1913, 424, 478.

[2] *Bull. Assoc. Chim. Sucr.*, 17, 699.

[3] *I.S.J.*, 1922, 149.

This Bulletin gives one the most detailed information regarding the new method of milling control first put into operation in Java (we believe) in 1916. Certain critics have urged that this new method is too intricate and elaborate for practice; but careful consideration by the Station chemists and others has shown that, if the fullest possible insight into the results of milling is to be obtained, the many data, in the calculation of which much time must be expended, are really necessary. Moreover, it can now be said that this so-called "new control" has justified itself by the useful results which have been obtained during the past few years regarding the amount and the sucrose content of the several mill juices separately, which results have clearly demonstrated that unless precautions are taken to prevent decomposition due to micro-organisms by the sterilization of gutters and tanks, an appreciable loss of sucrose results during the process of milling.

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An Introduction to the Physics and Chemistry of Colloids. Emil Hatschek. Fourth Edition; entirely re-written and enlarged; with 20 illustrations. (J. & A. Churchill, London.) 1922. Price: 7s. 6d.

On the appearance of previous editions of this small book[1] (which were based on a course of lectures delivered at the Sir John Cass Technical Institute, London), we pointed out its great value as an elementary textbook for those desiring to obtain an insight into the study of the important subject of the colloid state. Mr. HATSCHEK has now re-written and enlarged his "Introduction," the changes made being caused partly by the publication of important recent work on fundamental aspects of the science, and partly by increased experience in teaching the subject to students of very varied attainments and interested in every branch of chemistry and of chemical industry. At the same time the general character of the book has been preserved. It now forms a remarkably clear and concise summary of the physics and chemistry of the colloids, which we confidently recommend to those who realize the bearing of the subject on many of the problems which confront them in their particular branch of work. Recent literature published on the clarification of sugar juices and on the nature of molasses indicates the possible future importance of this study for the solution of these and other questions arising in the practice of our industry; and chemists desiring to be in touch with such developments would do well to read Mr. Hatschek's admirable summary of what undoubtedly is (adopting his own expression) "a fascinating branch of physical science."

Physics and Chemistry of Colloids and their Bearing on Industrial Questions. Report of a General Discussion held jointly by the Faraday Society and the Physical Society of London. (H.M. Stationery Office, London.) 1922. Price: 2s. 6d.

List of contents: Introduction; emulsions and emulsification; physical properties of elastic gels; glass and pyrosols; non-aqueous colloidal systems; precipitation of disperse systems; electric endosmosis and cataphoresis.

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[1] *I.S.J.*, 1916, 39; 1919, 189.

Brevities.

During the first quarter of 1921, the Badische Anilin u. Soda Fabrik manufactured 22,000 gallons of alcohol by the carbide synthetic process for the preparation of "reparation dyestuffs." A factory for the production of 660,000 gallons of alcohol annually by the same process is now under construction at Burghausen, Bavaria.[1]

Regarding the production of alcohol-ether motor fuel, an American firm specializing in the construction of distillery plant states that in a sugar-producing country where molasses is worth 2 cents a gallon; fuel oil about $2·50 a barrel; and labour $2 to $3 per day, the cost works out at 15 cents per American gallon approximately. This includes interest on money invested in the plant, maintenance of plant, and sinking fund, as well as the cost of the denaturing substances that may be used.

It is reported[2] that successful trials have been made in Louisiana and in Porto Rico with the Vachier filter. This is described as a leaf-type pressure filter with plates made of a special wire cloth, a means of mechanically scraping the cake from these plates and removing it also being provided. Juice from the heaters can be passed through this filter continuously (it is stated), and passed directly to the evaporator supply tanks. The filter was originally designed to deal with separation of decolorizing carbon from juice.

We have received samples of "German Rum" the manufacture of which from beet juice was recently described in these columns,[3] and have submitted them to experts who have had considerable experience in the manufacture of the genuine spirit in the West Indies. The substance of their opinion, stated before the origin of the samples was divulged, was that these samples represented an inferior grade of rum; that they appeared to be highly flavoured (the odour of amyl acetate being particularly pronounced); and that they could not really be regarded as even equal to the lower grades of Jamaica or Demerara rum.

The Blackstrap Fuel Potash Products Co., of which Dr. D. L. G. Hilderbrandt is president, proposes to establish several factories in Cuba in different localities for the conversion of waste molasses into alcohol motor fuel and potash.[4] According to this scheme 100,000 gallons of the molasses at 2 cents per gallon will yield alcohol of a total value of $48,000 and 560,000 lbs. of commercial potash worth $56,000, a total of $104,000. Calculating on 1,000,000 tons of molasses, the raw material would cost $20,000, and the production $41,000, so that the net profit estimated by Dr. Hilderbrandt would be $80,000 for the amount stated.

The *Times Trade Supplement* points out that the extent to which refined sugar has been able to compete with the higher grade of local sugar in Jamaica is shown by the fact that when refined sugar was dutiable in the past, imports for six years amounted to £88,000. When it was placed on the free list importations went up to £751,000. For seven years following the imposition of a duty of 1d. per lb., the imports decreased to £231,000 per annum. A reduction of the duty to ½d. per lb. had the effect of increasing imports to £642,000. Now it is intended that refined sugar entering Jamaica shall pay a duty of ¾d. per lb., to give a bounty of £7 per ton to locally grown sugar.

We regret to announce the death on March 25th, of Prof. W. B. Bottomley, who for many years occupied the Chair of Botany at King's College, London; and was well known for his researches on the nutrition of plants. His organic plant fertilizer "Humophos" for the protection of which he has taken out patents,[5] is now being manufactured in Yorkshire. Its analysis shows it to contain: nitrogen (as ammonia), 1·3; citrate soluble phosphate, 3·9; insoluble phosphate, 3·0; and potash, 0·2 per cent. But these figures do not indicate the nature of the fertilizer. It contains organic matter in a form immediately available by the plant, the remainder becoming accessible under the action of soil organisms. It contains nitrogen-fixing bacteria, introduced during the process of manufacture. And further it is claimed to contain accessory food substances, which are not actually nutrients, but rather stimulants, enabling the plants to utilize to the best advantage the food materials supplied to them. A number of good testimonials regarding the value of "Humophos" have been published.[6]

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[1] *Chimie et Industrie*, November, 1921.

[2] *La. Planter*, 1921, 67, No. 23, 361.

[3] *I.S.J.*, 1922, 33–35.

[4] *La. Planter*, 1921, 68, No. 3, 41.

[5] *I.S.J.*, 1915, 577; 1919, 360.

[6] See also *I.S.J.*, 1916, 222, 233, 357, 472; 1917, 284, 429; 1920, 54.

Review of Current Technical Literature.[1]

QUANTITY OF NON-SUGARS PRECIPITATED IN DIFFERENT METHODS OF CLARIFICATION, VIZ., DEFECATION, SULPHITATION, AND CARBONATATION.

(1) *W. Young. Archief, 1922, 30, No. 1, 1.* (2) *F. Leistra. Ibid., 1922, 30, No. 1, 1-3.*

Since the amount of non-sugar removed from the juice during clarification must be by no means an unimportant figure (a high or low rendement apparently being coupled with it), Mr. YOUNG has compiled from the Java mutual chemical control data for the years 1915-18 the following figures:—

Method of Clarification used.	Non-sugar removed per 100 originally present in the juice.
Defecation	12·02
Sulphitation	8·89
Carbonatation	19·69

and since these figures were obtained from 206 defecation, 181 sulphitation, and 66 carbonatation factory returns they must be regarded as good average values. As one might expect, they show that the most non-sugar is removed in the carbonatation method of working, from which one would conclude that it should give the highest yield; but they also indicate (what will be contrary to the preconception of many chemists) that less non-sugar is eliminated in sulphitation than in the ordinary defecation process, though in the former much more lime is added.

(2) Mr. LEISTRA replies to this communication by saying that before one can conclude from the figures given that carbonatation should give the highest yield, one must prove the following four points: (1) That the same degree of exactitude can be claimed for the figures relating to three different methods: (2) That the juices worked were alike in all three methods; and when one considers the location of the factories (in Pasoeroean and Besoeki 35 per cent. apply defecation and 0 per cent. carbonatation, whereas in Soerakarta and Djocjakarta these proportions are 8 and 45 per cent.), and also the fact that the soil exerts an influence on the nature of the juices, this conclusion does not seem valid. (3) That the operation of clarification in all three methods is carried out in an equally thorough manner, which again is a conclusion that may not be justified, since it seems likely that carbonatation is worked more carefully than are the other two methods, faults in the former being much more serious than in defecation or sulphitation. (4) That the non-sugar precipitated is of the same nature in all three methods in regard to the formation of molasses, this once again being a questionable conclusion to draw.

IMPRACTICABILITY OF THE RECOVERY OF SUCROSE FROM CANE MOLASSES BY THE STEFFEN DESACCHARIFICATION PROCESS.

H. C. Prinsen Geerligs. De Indische Mercuur, 1922, 45, No 2100, 18-22.

In his review of Murke's recently published work entitled "A Condensed Description of the Manufacture of Beet Sugar,"[2] Dr. GEERLIGS had expressed the desire to treat cane molasses according to the special mode of working described by the American technologist. This he has now had the opportunity of doing. Using very finely ground lime, and following the details prescribed in the volume mentioned,[3] he obtained a heavy precipitate of calcium saccharate, which, however, on being decomposed with carbon dioxide, gave after filtration a liquid the purity of which was very low. Notwithstanding all the precautions taken, the conclusion was the same as that obtained by him 20 years ago in Java, namely, that it is not possible to treat glucose containing molasses according to the Steffen process. Dr. GEERLIGS communicated this finding to Mr. MURKE, who replied that factory tests carried out by him with refinery molasses containing glucose had similarly led only to disappointment. It is explained that in addition to sucrose, glucose also forms insoluble compounds with lime, so that in the saccharate cake there is present a large amount of glucosate, which causes the contamination of the juice obtained after carbonating. Therefore, the conclusion already stated by Dr. Geerligs as the result of his earlier experiments is again confirmed, namely that desaccharification by the Steffen process of molasses containing much glucose is impracticable.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*

[2] *De Indische Mercuur*, August 12th, 1921.

[3] Pages 114-128.

Sucrose-Salt Combinations, and Geerligs' Theory of the Formation of Molasses.

W. D. Helderman. Archief, 1921, 29, 1167-1173.

In his original contribution to this subject,[1] Dr. Helderman had omitted to publish the results of the analyses of the liquid phase, having deemed it sufficient to describe the solid phase which stood in equilibrium with the analysed solution. However, in view of Dr. Prinsen Geerligs' article,[2] and also of a note inserted by the Editor of the *Indische Mercuur*, in which doubt was expressed respecting the conclusions drawn, it has seemed desirable to publish the complete analyses, and thus remove all reason for doubt respecting the results found. These analyses, therefore, are now given in full for the various systems of sucrose-salt-water, examined by him, the salts being potassium sulphate, sodium chloride, potassium oxalate, potassium chloride. Graphs are given for the illustration of the results obtained.

Inefficiency of the Decolorizing Carbon prepared from Beet Carbonatation Scums.

Zdenek Vytopil. Zeitsch. Zuckerind. Cechoslov. Republik, 1922, 45 (iii), No. 22, 249.

Further experience with the carbonized beet scums, prepared in the manner previously described,[3] leads the author to admit that the product can hardly be regarded as a useful decolorizing carbon for juices and syrups. Its decolorizing power is insufficient, and its production in uniform quality is difficult.

Analyses of Fijian Wild Cane, Roots of Dragon Tree, Exudation from Myoporum Platycarpum, and some Australian Fruits.

Thomas Steel.[4] Proceedings of the Linnean Society of New South Wales, 1921, 46, Part 4, 487-491.

Fijian wild cane.—The banks of the fresh water rivers of Fiji are covered with a dense tangled growth of a long slender cane, called Vico by the Fijians, but no use appears to be made of it. There are two kinds red and yellow, and it is considered to be a variety of *Saccharum officinarum*. Mr. Steel has made analyses of four different samples, and at the same time also of the native cane known as "Anani" and the introduced variety named "Honolulu," which latter was largely grown in Fiji at the time when the samples were collected, viz., November, 1885.

	Wild Cane.				Sugar Cane.	
	Red.		Yellow.		"Anani."	"Honolulu."
Sucrose	3·33	1·68	3·16	3·27	10·88	15·08
Reducing sugars	1·00	1·68	0·97	0·74	0·52	0·61
Other organic matter	1·37	1·56	1·71	1·58	1·73	0·80
Ash	1·59	1·30	1·75	1·55	0·62	0·49
Fibre	22·48	18·46	26·15	27·08	15·54	11·98
Water	70·89	75·80	66·80	66·38	71·52	70·52
	100·66	100·48	100·54	100·60	100·81	99·48
Average weight per stalk in kg.	0·38	0·61	0·45	0·51	—	1·51

Roots of Dragon Tree.—In Fiji the long conical roots of the Dragon tree (*Cordyline terminalis*) are roasted and used as food. Prior to cooking, they are white and contain a large proportion of inulin, which during roasting becomes transformed into levulose, the roots then being soft and having the appearance of having been soaked in molasses. In the Friendly Islands the roasted roots are fermented, and a spirituous liquor distilled from them.

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[1] *I.S.J.*, 1921, 509. [2] *I.S.J.*, 1921, 511. [3] *I.S.J.*, 1922, 42.

[4] Formerly Chief Chemist, Colonial Sugar Refining Co., Ltd., of Sydney.

	RAW.	ROASTED. 1.	2.
Levulose	3·32	38·53	40·49
Inulin, etc.[1]	30·19	—	—
Caramel, etc.	—	10·85	6·93
Ash	0·86	1·00	1·26
Fibre..	11·59	12·58	14 06
Water	52·98	38·00	38·64
	98·94	100·96	101·38
Weight of roots in kg.	1·64	2·08	1·30

Exudation from Myoporum platycarpum.—This was a dark brown sugary mass exuding from punctures of the tree made by insects, and contained: mannitol, 44·0; reducing sugars, 5·4; grms., etc., insoluble, 40·8; ash, 1·9, and water, 7·9 per cent.

Some Australian Fruits.—These were: *Eupomatia laurina*, *Ficus macrophylla*, *F. Cunninghamii*, *Ficus rubiginosa*, edible fig, and *Podocarpus elata*, and on analysis the total sugar content (dextrose and levulose) was found to vary from 0·30 to 13 per cent.; the seeds, fibre, pectose, etc., 3 to 40; and the ash from 0·4 to 2 per cent.

SUGAR LOSSES IN (GERMAN) REFINERY OPERATION. G. Schecker. *Vereinszeitschrift, 1922, 133-138.*

This writer discusses conditions of operation in the German refinery in respect of the loss of sugar which may occur at the char filters; during boiling by entrainment; and by inversion in after-product working. His remarks apply distinctly to continental practice, though nevertheless they are of some general interest. First he points out (what in fact is generally known and recognized in all refineries) that it is necessary to sweeten-off the boneblack with very hot water, otherwise a large amount of sugar will be retained by absorption; and this must be continued until the water leaving the filters contains only a few tenths of a per cent. of sugar, one being guided by the taste, or better by the α-naphthol test. Regarding the loss by entrainment, he states that in normal operation the sugar in the condenser water should not exceed 0·007 per cent., which in 200 per cent. boilings corresponds to about 0·2 per cent., calculated on the weight of raw melted. If, however, the syrups contain invert sugar they froth in the vacuum pans, and in particularly bad cases may even give rise to a phenomenon resembling "froth fermentation" with the evolution of carbon dioxide. Blame for a comparatively high loss of sugar by entrainment in this way can hardly be laid to the pan-men, but rather rests on the manager, who permits the production of syrups containing invert sugar, the result of the gradual disappearance of the alkalinity. Many refiners appear to be afraid of using lime. Experience shows that syrups which are free from invert sugar, and which do not froth, are only obtained if the massecuites always remain distinctly alkaline to phenolphthalein, having namely 0·001–0·002 per cent. in the first massecuites, and 0·05 to 0·10 per cent. in the molasses, and if their alkalinity is less an acid reaction may set in, and a greater or less amount of invert sugar may be formed. In the writer's refinery 250 kg. of lime are added per 400 tons of raw sugar melted daily, that is, 0·063 per cent.; and the raw sugar contains 0·054 per cent. combined with organic acids. As 9·3 kg. of molasses are produced per 100 of raw sugar, the lime in this molasses should be 1·26 per cent. (as CaO). However, only 0·73 per cent. is present, leaving a balance of 1·26 — 0·73 = 0·53 per cent. (calculated on the molasses), which is accounted for by the scum separated in the sand filters which mostly consists of calcium carbonate.

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[1] No starch was present.

DETERMINATION OF THE EFFICIENCY OF DECOLORIZING CARBONS. *J. W. Turrentine and H. G. Tanner. Journal of Industrial and Engineering Chemistry, 1922, 14, No. 1, 19-20.*

Carbons being specified in their action, it is desirable to test them under conditions as nearly parallel to those obtaining in their application on the large scale, the method recommended by the authors (which is claimed to combine reliability with speed) being as follows:—A stock solution is prepared by dissolving 50 grms. of molasses in about 1000 c.c. of water, neutralizing with sodium hydroxide or acetic acid, and 3 c.c. of glacial acetic acid, 15 grms. of sodium acetate, and 2 c.c. of formaldehyde added. In carrying out the test, 80 c.c. of this stock solution are brought to boiling with 2 grms. of the carbon under examination, the mixture filtered while still hot, and the filtrate matched with a set of filtrates prepared in the same manner but with different quantities of a standard carbon. Then the weights of carbon required to produce the same degree of decolorization are taken to represent the relative efficiency, the ratio being calculated to a percentage basis with the standard carbon as 100. Sodium acetate serves to maintain a constant H-ion concentration throughout a series of tests, an important point, since the amount of colour adsorbed by a carbon is very sensitive to changes in reaction, especially near the neutral point. Some carbons contain a small amount of acid and others of alkali; and if the sugar solution be neutral, or if it be not fortified against changes in the concentration of either H or OH ions, one will be tested in an alkaline and the other in an acid medium, the results then being far from comparable.

"KELP-CHAR" AS A DECOLORIZING AND PURIFYING AGENT. *J. W. Turrentine and H. G. Tanner. Journal of Industrial and Engineering Chemistry, 1922, 14, No. 1, 19-24.*

ZERBAN established[1] that a good decolorizing carbon could be made from the Pacific Coast kelp, *Macrocystis pyrifera*; and now this material is being made in a small plant at the rate of 1000 lbs. per day, having been put on the market under the name of "Kelp-char." In this paper the authors review the possible application of this decolorizing carbon, in sugar manufacture and refining, in glucose and malt syrup manufacture, in oil refining, in the precipitation of gold in the cyanide process, etc. In discussing the re-activation of the material by heating, the following disadvantages are mentioned:—The carbon must be dried; the plant is costly to construct and operate; the operation is tedious; and loss by the escape of dust occurs. But they say that if the expense incurred is allowable in the case of boneblack, it is relatively insignificant in that of decolorizing carbons. They consider wet methods more promising, that is using alkali and acid, and good results were obtained by retorting the carbon at 800°C., cooling, washing with hydrochloric acid, then with water, and lastly drying. Under the heading of the characteristics of a good decolorizing carbon, they write: "While it is hoped that a carbon will be offered the trade which is both highly active and at the same time cheap enough to warrant its throwing away after one usage, the probabilities are that the cost of re-activating will always be less than that of manufacturing. If carbons are to be used repeatedly, unless their particles are hard they will break down under repeated handling and eventually be objectionably fine."

DISTILLATION AND RECTIFICATION OF LIQUIDS CONTAINING ALCOHOL. *L. Gay. Chimie et Industrie, 1921, 6, No. 5, 567-578.*

In continuation of his previous communications on this subject,[2] the author remarks that in order to obtain the maximum efficiency from a column, *ceteris paribus*, the higher the temperature of the initial mixture, the lower should be the level of its introduction into the distillation apparatus. This level should be such that an initial liquid meets another of approximately the same composition in the column.

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[1] *I.S.J.*, 1919, 86; 1921, 230.

[2] *Chimie et Industrie*, 1920, 3, 157; 1920, 4, 178; See *I.S.J.*, 1920, 709.

PREPARATION OF GLUCONIC ACID FROM DEXTROSE OR INVERT SUGAR.

A. R. Ling and D. R. Nanji. Journal of the Society of Chemical Industry, 1922, 41, No. 3, 28-29 T.

Two objections from the economic point of view might be raised against the process of preparing gluconic acid elaborated by HERZFELD and LENART,[1] viz., the quantity of bromine used (which is more than the theoretical amount), and the time necessary to complete the oxidation. These objections are overcome, and generally the process is much improved, by the use of calcium bromide. A quantity of this compound which corresponds in potential bromine content with 26 per cent. of that recommended by the German investigators is mixed with a 20 per cent. solution of dextrose containing 0·025 per cent. of cobalt nitrate as catalyst, and a slow well-regulated current of chlorine (about 1 bubble per sec.) passed in, the temperature being maintained at 45–50°C., not higher. As the reaction proceeds, there is a constant accumulation of halogen acids, and to avoid their retarding influence, calcium carbonate is added from time to time. The reaction is complete in about four hours. When it has been allowed to proceed normally so that no secondary changes have occurred, the solution will contain calcium gluconate, calcium chloride, and calcium bromide, and when appropriately concentrated the former will be deposited after a few days. If care be taken in working up the mother-liquors, the yield of calcium gluconate is about 90 per cent., and higher if strong alcohol be added to the aqueous solution of the calcium salt.

FACTOR NECESSARY FOR THE CONVERSION OF THE SULPHATED TO THE CARBONATED ASH IN THE CASE OF BEET FACTORY PRODUCTS.

Jar. Mikolasek. Zeitsch. Zuckerind. cechoslov. Republik, 1922, 45 (iii), No. 22. 246-247.

Many chemists have pointed out that the deduction of one-tenth for the conversion of the sulphated to the carbonated or "true" ash is short of the truth, and once again this finding is confirmed. Determinations of the ash of beet molasses obtained during the past four campaigns in Bohemia by the two methods under discussion show that instead of 10 per cent., the average deduction works out at 21·44 per cent., and is approximately the same for beet sugars also.[2] An analysis of the carbonated ash of a beet molasses was made, and the saline constituents were then calculated to the corresponding sulphates, the following results being obtained :—

Carbonated Ash.		Sulphated Ash, calculated from the Carbonated Ash.	
Insoluble in HCl	0·01	SiO_2	0·010
$Fe_2O_3 + Al_2O_3$	0·12	$Fe_2O_3 + Al_2O_3$	0·120
$CaCO_3$	0·42	$CaSO_4$	0·571
KCl	0·71	K_2SO_4	0·830
K_2SO_4	0·72	K_2SO_4	0·720
K_2SiO_3	0·05	K_2SO_4	0·056
		SiO_2	0·020
K_3PO_4	0·13	K_2SO_4	0·200
K_2CO_3	6·33	K_2SO_4	7·980
Na_2CO_3	1·11	Na_2SO_4	1·488
	9·60		11·995

However, analysis gave a direct determination of the sulphated ash of 12·155 per cent., as compared with the 11·995 per cent. calculated above, the difference being of course due to the loss during the incineration of the carbonated ash. Taking this loss into consideration, the correction for the sulphated ash becomes 21·44 — 1·31 = 20·13 per cent.; so that in round figures the deduction is 20 per cent., in other words, the sulphated ash should be multiplied by the factor 0·8, instead of the customarily applied 0·9.

J. P. O.

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[1] I.S.J., 1920, 171.

[2] OGILVIE and LINDFIELD found the deduction necessary for the samples of beet molasses examined by them to be 14 to 18 per cent. See I.S.J., 1918, 114–117.

Review of Recent Patents.[1]

UNITED STATES.

INTERMEDIATE FEED CHUTE FOR MILLS. *Joseph Meinecke*, of Paia, Maui, T. H *1,401,095*. December 20th, 1921 (Three figures; seven claims)

In the drawings (Fig. 1) are shown two mills of a series, between which the conveying apparatus is arranged, the improved chute being designated generally at *13*. This chute is oppositely inclined between the discharge end of the preceding mill and the feed end of the succeeding mill, and includes a bottom plate *14*, arranged at an angle of 30–45°, preferably 45° from the horizontal at the feed end of the succeeding mill, said plate being disposed in an inclined position and having inclined and joined therewith to extend in an opposite direction, a bottom plate *15*, which like the bottom plate *14* and other parts of the chute, is constructed of sheet metal. The bottom plate *15* extends at an angle of from 30 to 35°, preferably 30° from the horizontal at and from the discharge end of the preceding mill, so as to give less inclination at the discharge end of the mill or greater inclination at the discharge end of the chute and obviate excessive pressure attendant with macerating mills and in employing the ordinary curved chute with macerating

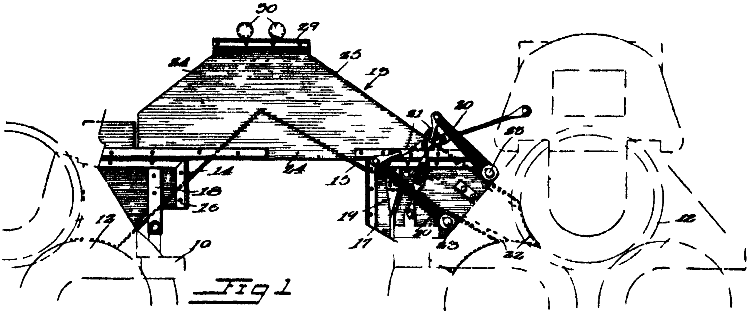

Fig 1

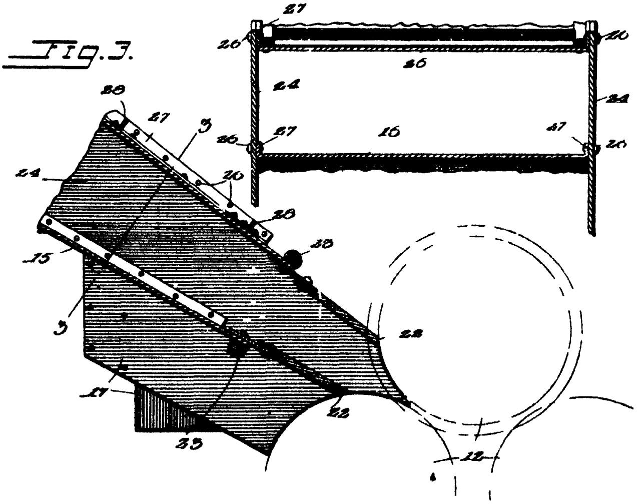

Fig. 3.

Fig. 2.

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[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W C 2 (price, 1s each) *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 37, rue Vieille du Temple, Paris (price, 2fr 00 each).

scrapers. The chute is supported at either side upon suitable structure of the frames of the mills, side-plates *16* and *17* being provided for this purpose, which are reinforced by braces *18* and *19* in conjunction with the actuating parts including arms *20* and the adjustable turnbuckle toggle joints or connexion rods *21* arranged at the discharge end of the chute. It will thus be seen that the chute has the bottom plates thereof arranged at a certain inclination with respect to the horizontal and to each other, so that the bagasse is pushed up one side and down the other to withstand the enormous attendant pressure, the apex of the chute being substantially equi-distant between the two mills, but with a greater inclination at the feed end of the mill than at the discharge end, or at the discharge end of the chute, and at the feed end. At the discharge end of the preceding mill or feed end of the chute scrapers *22* are provided which are cast in and have connexions with the arms *20* through the pivots *23* allowing for the neccessary contact, adjustment and tensional regulation through the medium of the turnbuckle connexions *21*.

The sides of the chute are designated at *24*, the side and bottom portions inclining from the transverse line of the apex of the chute to the opposite side. One of said sides, namely, the side having the plate *15*, is provided with a cover plate *25* at the discharge end of the preceding mill or feed end of the chute which is removably bolted in position as indicated at *26*, twelve of such bolts being employed so as to render removal of the cover and cleaning of the chute readily possible. The cover is provided with a flange *27* at its side edges to render the attachment convenient and said cover is suitably reinforced transversely as indicated at *28*, while the intermediate portions of the sides of the chute are provided with horizontal supporting brackets or flanges *29* bolted in position and supporting the macerating pipes *30* leading from a suitable source of water supply, so that the bagasse is sprinkled as it comes out of the chute and is discharged down the inclined side *14*, the top of which is open. Thus, the bagasse is taken on the discharge side of the preceding mill or feed end of the chute adjacent to the scrapers and shoved up the bottom of the chute which is covered or closed and which has the lesser inclination, the bottom portion or plate delivering the bagasse in an upward direction upon the inclined portion or bottom plate *14* of greater inclination so that the discharge is freed of pressure, thus delivering the bagasse to the succeeding mill without any movable parts or excessive pressure causing destruction, distortion, or injury to the chute. The bagasse is furthermore delivered in an upward direction with a gradual taper and a completely closed chute is unnecessary and therefore attendant objections to such devices are overcome. The bagasse slides down the discharge chute or bottom plate without any assistance and the macerating water is applied as the material comes out of the chute on its downward movement. That is, there is no pressure on the bagasse as the chute is gradually tapered and there is only a pressure tending to shove the material from the discharge roller into the receiving mill, thus avoiding all movable parts or alterations in the design of the mill with obvious advantages manifest to anyone acquainted with the art. Also, by reason of the construction provided there is considerable clearance beneath the chute and this is an important factor in the operation of the mills. It is also to be noted that the top portion of cover *25* extends at an angle from 30 to 35° from the horizontal, preferably 35° when the bottom plate *15* is disposed at an angle of 30° from the horizontal, causing the covered portion of the chute to be wider at its discharge end than at its receiving end adjacent to the scrapers, so as to free the pressure which would otherwise be attendant in the conveyance of the bagasse. (Reference is made to the prior patents: 1,191,826; 1,209,618; 1,204,314; and to devices employing a curved chute, the present invention being an improvement on these "in view of its simplicity of construction, economical production, and durability in use, as well as efficiency.")

Motor Fuel containing Alcohol, Gasoline (Petrol), Kerosene, and a Terpine. *Milton C. Whitaker* (assignor to the *U.S. Industrial Alcohol Co.*, of West Virginia). *1,405,809.* February 7th, 1922. (Six claims.)

Claim is made for (1) a fuel consisting mainly of gasoline, kerosene, and an alcohol, and containing a blending agent comprising a "terpine."

Clarification in Inulin and Levulose Manufacture. *Arnold Daniel*, of Charlottenburg (assignor to *The Chemical Foundation, Inc.*, of Delaware, U.S.A.) *1,399,544*. December 6th, 1921.

Claim 1.—The process of obtaining inulin from juices which comprises heating the juice for about 30 to 90 mins. at a temperature of about 80°C., adding an alkali belonging to the alkali metal group during the heating until an excess is shown, filtering and evaporating to crystallization.[1]

Cooling Chocolates. *Frederick W. Leyland and Edward P. Brock*, of Boston, Mass., U.S.A. *1,389,887*. September 6th, 1921.

Recovery of Sugar from Molasses. *Holger de Fine Olivarius*, of San Francisco, California, U.S.A. *1,401,433*. December 27th, 1921.

Claim is made for the process of recovering sugar from molasses, which includes: Mixing the molasses with alcohol, adding an amount of lime to the solution to precipitate organic and colouring matters without precipitating the sucrose, separating the precipitate from the solution, and agitating the alcoholic solution in the presence of a further amount of lime, whereby substantially all the sucrose is precipitated as calcium saccharate.

Motor Fuel containing Alcohol, Ether, and Aniline. *John P. Foster*, of Paia, Maui, T. H. *1,384,946*. July 19th, 1921.

It has long been recognized that the explosion of alcohol alone or in combination with ether gives rise to certain acid decomposition products which act destructively on the metallic parts of the engine; and that in order to minimize this disadvantage it has been proposed to mix with the fuel certain reagents, such as ammonia, pyridine, methylamines and ethylamines, etc. But what has not been previously recognized is the fact that in mixtures of alcohol and ether, chemical decomposition is continually taking place by oxidation, from the time that the fuel is manufactured until it is ultimately consumed. Corrosive compounds are formed, the efficiency value of the fuel is decreased, and the storage tanks or containers are impaired. It has, however, been discovered by the inventor that the addition of aniline or phenylamine, $C_6H_5NH_2$, to the mixture of alcohol and ether is wholly effective in preventing all deleterious reactions in the mixture, which can then be kept indefinitely without danger of chemical change. Furthermore, the aniline is effective in completely neutralizing the products of combustion preventing the attack of the engine parts, besides which the aniline is of such a nature that it is completely expelled from the engine along with the products of combustion. Aniline is in itself stable, basic in character combining readily with acids to neutralize them and form salts soluble in alcohol and ether. It is miscible in all proportions in alcohol and ether, and possesses the necessary high boiling point and low freezing point; moreover, it is reasonably low in cost and is available almost everywhere the other constituents of the fuel are obtainable.

A typical admixture for tropical and sub-tropical climates consists of ethyl alcohol, 63 per cent.; ethyl ether, 34; kerosene, 2; and aniline, 1 per cent., all by volume. In colder climates the ether may be largely increased, say to 45 per cent., or more. Generally speaking, the greater the proportion of ether, the more aniline is required, but in cold weather and at high altitudes the aniline may be reduced. Conversely, in hot and humid weather, a relatively larger proportion of aniline may be employed. Again, when the fuel is made for immediate use the proportion of aniline used may be less than would be required if the fuel is to be stored for an extended time. Claim is made for: A motor fuel comprising an admixture of the following compounds in substantially the proportions by volume indicated; alcohol, 63; ether, 34; kerosene, 2; and aniline, 1 per cent. by volume.

Beet Topper. *Walter Hoagg*, of Detroit, Mich., U.S.A. *1,401,079*. December 20th, 1921.

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[1] See *I.S.J.*, 1921, 270, 492.

GERMANY.

Purification of Juice, using Basic Aluminium Carbonate. *István Hunyady and Milán Malbaski*, of Mezöhegyes, Hungary. *344,485*. July 15th, 1917.

Claim is made for the process of purifying juice characterized by treating with basic aluminium carbonate, which is produced by adding a solution of ammonium alum[1] (saturated at 100° C.) to a cold concentrated solution of ammonium carbonate or bi-carbonate while continuously stirring, the temperature of the liquid not being permitted to rise above 30° C. Thus prepared, the basic aluminium carbonate is well washed. In application it is added to the cold or hot juice in amount corresponding to the quality of the juice (0·5 to 3 per cent.), the mixture heated to 85–100° C. in a closed vessel while stirring, the carbon dioxide evolved being led away. After subsiding, the precipitate is separated and filtered, while the juice is sent directly to the evaporators without further treatment, or it may again be treated with more basic aluminium carbonate (a few tenths of a per cent. this time), after which it is concentrated in the evaporators in the customary manner to 60–85° Brix, filtered hot, and boiled to grain. Regarding the precipitate separated at the first treatment, this may be used again after the addition of some freshly prepared basic aluminium carbonate. Revivification of the precipitate is effected by heating under pressure to a temperature exceeding 100° C., with a solution of ammonium sulphate, filtering, cooling, separating the crystals of ammonium aluminium sulphate thus obtained from their mother-liquor, re-dissolving in water to a saturated solution at 100° C., and adding to a cold concentrated solution of ammonium carbonate in the manner already described, basic aluminium carbonate being thus recovered for re-use. Juice clarified by this process (it is stated) is crystal clear and slightly alkaline.

UNITED KINGDOM.

Juice Heating by Direct Contact with Steam. *W. Mauss*, of Johannesburg, Union of South Africa. *173,709* (*7454*). March 8th, 1921.

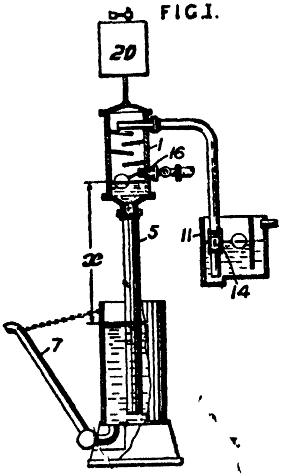
FIG. 1.

Juice or other liquid is heated by direct contact with steam, and the temperature regulated by the pressure of a head of liquid. Heating can thus be effected continuously, and since the quantity of steam consumed is exactly regulated to the requirements at any moment, economy of fuel is assured without the possibility of the liquid being insufficiently heated. Fig. 1 shows apparatus for heating under a pressure less than atmospheric. Juice is syphoned into the heating chamber *1* from a vessel *11*, the rate of flow being regulated by a float-controlled butterfly valve *14*. Steam is admitted by a float-controlled valve *16*, the pressure being regulated by the height x of the column of liquid in the pipe *5* which can be regulated by a swivel overflow pipe *7*. A vacuum chamber *20* draws off non-condensible gases. By curving the pipe *5* upwards, a pressure above atmospheric can be obtained. Claim is made for (1) the process of heat treating liquid, which consists in balancing the pressure within a vessel by a liquid column, passing liquid and steam into the vessel, and controlling admission of the steam according to the height of the liquid column; (2) apparatus for heat treating liquid, consisting of a closed vessel, means to feed the liquid thereto, a liquid outlet adapted to retain a column of liquid balancing the pressure within the vessel, an inlet for steam, means controlled by the height of the liquid column and controlling the inflow of steam, and means to pass surplus gas from the vessel.

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[1] Prepared in the known manner by mixing a concentrated solution of aluminium sulphate with a concentrated one of ammonium sulphate, the less soluble ammonium aluminium sulphate (commonly known as ammonium alum) separating out as a crystalline double salt.

MANUFACTURE OF DECOLORIZING CARBON. *Johan N. A. Sauer*, of Amsterdam, Holland. *173,624 (28,682)*. October 9th, 1920.

It is the essence of this invention to employ the following features in combination with each other, each having its particular function in producing the result aimed at: *(1)* The raw material must be a vegetable substance, e.g., wood or wood charcoal, having a definite fibrous structure; *(2)* it must not contain much inorganic matter; *(3)* there must be no addition of inorganic matter in the course of the process; *(4)* the carbonization must be performed in a closed retort with injection of gas or steam at suitable stages; *(5)* the carbonized product must be ground in a dry state; and *(6)* the disintegration effected by grinding must not exceed to the stage at which the fibrous structure of the carbonized material is destroyed. None of these features is new[1]; but no prior specification has set forth the particular combination of them here indicated and has indicated that the grinding should proceed to the state mentioned. The high quality of the finished carbon for filtration purposes is in great part due to the retention of the fibrous structure by the carbon, and there must be no addition of inorganic constituents, which cause the carbon to be deposited on the particles of the inorganic matter in a state of very fine division, whereby the porous structure is broken up, apart from the further disturbance involved when dissolving out the inorganic matter.

In an example given, pine wood in a granular state (but not of the fineness of ordinary saw-dust is submitted to distillation, in the first stage of which the temperature is raised to about 400° C., proceeding so slowly that this operation lasts over six hours. Gaseous by-products are abstracted as quickly as possible, as, for example, by suction. In the second stage the temperature is raised to about 1200° C., and the charge maintained at this temperature for about six hours or more, passing superheated steam into the retort. In the third stage heating is carried on at about 1500° C. for about three hours without injection of any gas, or with injection of nitrogen. After cooling the charge sufficiently low to prevent oxidation on exposure to air, it is ground in a ball mill, until it almost all passes through a 20 to 30 mesh sieve, but rests on a 90 mesh. Nearly all the particles retained by the 90 mesh sieve have preserved their fibrous structure It is a remarkable fact that the disintegration heretofore in practice has more or less generally been carried to a degree of fineness which largely "kills" the carbon so far as its decolorizing and filtering properties are concerned. With carbon "killed" by excessive grinding, or carbon which is amorphous, owing to the nature of the raw material or the mode of manufacture, the minute particles are too closely packed during the separation of the carbon by filtration from the liquid treated, so that even a thin layer may become wholly or nearly impervious to liquid.

DECOLORIZING SUGAR JUICES, SYRUPS, ETC., BY THE USE OF AN ADSORBING AND REDUCING AGENT IN CONJUNCTION. *J. F. Straatman*, of Enschedé, Holland. *174,027* addition to *172,272* (*5656*). February 19th, 1921; convention date, January 13th, 1921; *not yet accepted;* abridged as open to inspection under Section 91 of the Act.

In the process for decolorizing sugar juices and other liquids by means of adsorbents and reducing agents described in the parent Specification,[2] formaldehyde-sulphoxylic acid, or its salts, such as sodium formaldehyde-sulphoxylate, is used as the reducing agent.

PRODUCTION OF YEAST FROM MOLASSES. *The Fleischmann Co.* (assignees of *M. Nilsson and N. S. Harrison*. *148,373*. July 9th, 1920.

Molasses is diluted with water mixed with phosphates and nitrogenous substances (e.g., ammonium salts), inoculated with yeast, and aerated for 24 hours while maintained at 25–30°C. It is stated that from 50 to 60 per cent. of yeast is produced.

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[1] The inventor has described the whole sequence of operations in an example given on page 8 of his prior specification No. 167,195, but without reference to the particular degree of fineness imparted by grinding.

[2] *I.S.J.*, 1922, 164.

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	One Month ending March 31st.		Three Months ending March 31st.	
	1921. Tons.	1922. Tons.	1921. Tons.	1922. Tons.
Unrefined Sugars.				
Poland	....	...	5,641	....
Germany	....	....	...	....
Netherlands	345	....	345	....
Belgium	....	....	....	...
France	....	..	....	....
Czecho-Slovakia	.	....	...	....
Java	2	....	17,101	1
Philippine Islands	....	....	....	....
Cuba	12,524	103,072	12,524	190,409
Dutch Guiana	555	688	625	1,487
Hayti and San Domingo	....	....	....	....
Mexico	....	...	....	....
Peru	19,753	2,855	43,635	23,726
Brazil	3,240	5,585	25,245	15,750
Mauritius	19,075	989	67,497	56,223
British India	....	....	....	....
Straits Settlements	....	....	....	....
British West Indies, British Guiana & British Honduras	3,375	8,556	23,954	25,005
Other Countries	2,459	5,784	6,333	12,738
Total Raw Sugars	**61,329**	**127,528**	**202,901**	**325,339**
Refined Sugars.				
Germany	....	....	1	....
Netherlands	17,850	2,254	18,296	10,155
Belgium	10,306	282	10,400	2,239
France	1,582	....	1,583	...
Czecho-Slovakia	12,444	1,092	13,437	18,157
Java	....	....	3	1
United States of America	5,400	21,882	5,556	47,675
Argentine Republic	....	....	....	....
Mauritius	...	....	...	....
Other Countries	2,565	3,638	3,999	9,242
Total Refined Sugars	**50,148**	**29,149**	**53,274**	**87,470**
Molasses	14,040	4,268	20,322	21,171
Total Imports	**125,517**	**160,945**	**276,497**	**433,980**

EXPORTS.

	Tons.	Tons.	Tons	Tons.
British Refined Sugars.				
Denmark	....	100	....	261
Netherlands	299	421	657	963
Channel Islands	175	79	400	255
Canada	....	....	....	1
Other Countries	260	1,791	737	4,000
	734	2,391	1,794	5,480
Foreign & Colonial Sugars.				
Refined and Candy	3	391	14	412
Unrefined	14	114	509	1,339
Various Mixed in Bond	....	....	....	....
Molasses	49	65	191	379
Total Exports	**800**	**2,961**	**2,508**	**7,610**

Weights calculated to the nearest ton.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1922. Tons.		1921. Tons.
Total Receipts, January 1st to March 29th	1,104,989	..	621,575
Deliveries ,, ,,	1,080,695	..	624,664
Meltings by Refiners ,, ,,	904,292	..	559,946
Exports of Refined ,, ,,	132,000	..	58,000
Importers' Stocks, March 29th	24,294	..	7,963
Total Stocks, March 29th	222,431	..	119,290
	1921.		1920.
Total Consumption for twelve months	4,107,328	..	4,084,672

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1919-1920, 1920-1921, AND 1921-1922.

(Tons of 2,240 lbs.)	1919-20. Tons.		1920-21. Tons		1921-22 Tons.
Exports	848,046	..	337,563	..	253,940
Stocks	383,296	..	499,519	..	414,512
	1,231,342		837,082		668,452
Local Consumption	16,500	..	20,000	..	20,000
Receipts at Ports to February 28th	1,247842		857,082		688,452

Havana, February 28th, 1922 J. Guma. L. Mejer.

United Kingdom.

BOARD OF TRADE STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR THREE MONTHS ENDING MARCH 31ST, 1920, 1921, AND 1922.

	IMPORTS.				EXPORTS (Foreign).		
	1920. Tons.	1921. Tons.	1922. Tons.		1920. Tons.	1921 Tons.	1922. Tons.
Refined..	69,957	53,274	87,470	Refined.	476	14	412
Raw	251,368	202,901	325,339	Raw.....	1,232	509	1,339
Molasses	32,081	20,322	21,171	Molasses	829	191	379
	353,406	276,497	433,980		2,537	714	2,130

HOME CONSUMPTION.	1920. Tons.		1921. Tons.		1922. Tons.
Refined	77,816	..	47,410	..	86,146
Refined (in Bond) in the United Kingdom	161,368	..	257,178	..	225,250
Raw	92,910	..	29,774	..	39,027
	332,094		334,362		350,423
Less Exports of British Refined	95		1,794		5,480
Total of Sugar	331,999		332,568		344,943
Molasses	11,594	..	2.875	.	1,652
Molasses, manufactured (in Bond) in United Kingdom	20,211	..	12,573	.	13,341
	363,804		348,016		359,936

STOCKS IN BOND IN THE CUSTOMS WAREHOUSES OR ENTERED TO BE WAREHOUSED AT MARCH 31ST, 1920, 1921, AND 1922.

	1920. Tons		1921. Tons.		1922 Tons.
Foreign Refined	59,150	..	34,800	..	16,550
Refined in Bond	26,750	.	25,950	.	27,950
Unrefined	175,050	..	264,000	..	165,400
	260,950		324,750		209,900

Sugar Market Report.

Our last report was dated 9th March, 1922.

Under the influence of the firm and hardening tendency of raws, and the general demand for refined sugars from this country, the U.S. and other places, the market was firm during the greater part of the month under review and prices advanced substantially. American Granulated c.i.f. U.K. ports moved up to 20s. 10½d. done for April/May shipment, and Tate's London Granulated to 49s., No. 1 Cubes 53s. 3d. spot, duty paid. White Sugar in the terminal market followed the general trend, up to 20s. 6d. landed, in bond, being paid for August delivery. Cuban 96° Centrifugals c.i.f. U.K. touched 14s. 4½d., whilst 2·$\frac{9}{16}$ was done c. & f. New York. On raw sugars becoming more freely pressed for sale, a reaction set in, and the subsequent dullness led to a shrinkage in values. Sentiment, however, having grown in favour of the article, considerable resistance was shown to any decline, and at this date the pendulum appears to be swinging once again in an upward direction. To-day American granulated is quoted 20s. 3d. c.i.f. April/May buyers; Tate's London Granulated 48s.; No. 1 Cubes 52s. 6d.; Cuban 96's 13s. 6d. sellers, 13s. 3d. buyers; August White Terminal 20s. 1½d. paid and value.

It is interesting to note the persistent enquiry for White Sugars from all parts, and the ease with which it has been possible to dispose of offers at good prices outside the U.K. Czecho-Slovak granulated arriving in Hamburg is being taken off for India and other destinations, probably Sweden and the Baltic, and enquiries for American are received from the Mediterranean, Canary Isles, etc. A good demand is also being met from France, Switzerland, occupied Germany, Rumania, etc.

With the avowed object of fostering the industry in this country the Government have removed the excise duty from all home-grown sugars, at a moment when it assists the factories to make their arrangements for the next crop.

There is little of fresh interest to report regarding European sowings, but advices from Germany continue to indicate that the preference given to cereals, potatoes and other crops requiring less labour than beet, and the small proportion of winter crops likely to be replaced by beet, will tend to restrict any increase in the acreage sown. It must be borne in mind, however, that there is room for an improvement in the cultural yield as against the indifferent results of last year occasioned by the drought.

In Cuba grinding is proceeding rapidly under favourable conditions, and to-day's cables give the following figures of receipts, etc., for the week ending 1st April:—

		1922.	1921.	1920.
Old Crop—	Receipts	3,133	6,422	nil.
	Exports	28,143	11,532	nil.
	Stock	167,000	57,576	nil.
New Crop—	Receipts	185,000	125,000	141,000
	Exports	123,000	93,000	105,000
	Stock	799,000	776,000	616,000
	Centrals grinding	184	195	185

According to Messrs. Blyth Brothers & Co., the quantity of Mauritius crystals remaining unsold in the hands of the Syndicate at 10th February was 40/45,000 tons. Owing to the abnormal wetness of the season these sugars are offered without being guaranteed dry. Total shipments to that date from the Island were 90,740 tons, comprising about 50,600 tons to Europe, 35,100 tons to India, and some 5,000 tons to other places.

The Indian budget regulations, referred to last month, have passed into law. In the meantime the local markets remain dull with no signs of revival in the demand. Quotations in the London market c. & f. Calcutta basis are rather higher than last quoted; there are sellers of June at 19s. 4½d., July 19s., July/Sept. 18s. 9d. Beyond certain quantities mostly for June shipment which were repurchased by the shippers, business during the month was comparatively small. After being firm in sympathy with the other markets, Java seems to be going through a dull and uninteresting time; present quotations are May delivery 13 guilders, June/July 11¾, August/Sept. 11⅝, sellers.

H. H. Hancock & Co.

10 & 11, Mincing Lane,
London, E.C. 3,
April 5th, 1922.

THE

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☞ The Editors are not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

The Budget.

"Intelligent anticipation" in the week preceding the announcement of the 1922 Budget proposals in the House of Commons on May Day included sugar as one of the "probables" that would be favoured in the matter of reduction of taxation; but after all this hope was dashed, since the Chancellor of the Exchequer (Sir ROBERT HORNE) decided that his contribution to the alleviation of indirect taxation must be confined to tea and its associates, cocoa, coffee, and chicory, which three are all linked up with tea in the matter of duties. Doubtless he had good reason for believing that an appreciable reduction in the tea duty (reduced from 1s. to 8d. on foreign sorts) would make a greater difference to the working-class household budget than a lesser reduction off several articles; we believe the average woman of these classes in this country indulges in tea five times a day or even more. All the same it is to be regretted that sugar has been left out of the favours conceded; the present duty on sugar, as we have already more than once pointed out, is excessive and restricts the consumption to a figure much below what the country can and should consume. It should certainly receive attention at an early date; but the Chancellor, having only a very limited sum available for concessions to taxation, has decided that it cannot be done this year. He has explained in the House of Commons in the subsequent debate that he would indeed have liked to give a reduction on the sugar duty, but any reduction that would reach the consumer would cost the Exchequer £11,000,000 a year and that was not feasible. A lesser reduction, in the opinion of the Treasury officials, would only benefit the pockets of the middlemen. So sugar has got to wait. Next year, unfortunately, it may have to compete with beer, which is heavily taxed and is, in the view of a large body of opinion that cannot be ignored, a strong claimant for relief. A great deal will depend on what surplus is then available in the further relief of taxation, and this in its turn depends on the extent to which more Government economies are possible and to the degree to which trade revives the next twelve months. The reduction of one-sixth in the income-tax, and cheaper postal facilities especially for light circulars,[1] will both help to stimulate trade; in fact, the demand for these two concessions by the trading community has been too strong to be ignored.

The Budget proposals, of course, include the already announced abolition of the Excise Duty on home-produced sugar; otherwise the only satisfactory feature in the sugar duties is that the sum of the preference accorded to Imperial sugar entering this country remains unreduced, being one-sixth of the duty of 2¾d. per lb. With sugar at its present low price, this will be some consolation to the overseas producers since a reduction in the duty by 1d. per lb. would have correspondingly reduced the value of the preference. But this is, of course, only a sectional advantage, and on the whole we should have thought it would have been better to have tried to stimulate the consumption by reducing the cost of sugar to the consumer. The last word has of course not been said on the subject, as the Finance proposals are still under discussion, but we do not anticipate any concession being made at the eleventh hour.

Kelham and Cantley Beet Factories.

Now that the Government has decided to take the necessary steps to remove the Excise Duty from home-grown sugar, the two factories at Kelham and Cantley, which would otherwise remain idle this year, are both expected to conduct a campaign this autumn. The two companies have issued identical appeals to farmers, and offered contracts in identical terms. The National Farmers' Union has sent out a special appeal to farmers, asking for their full support. In spite of the lateness of the date of the appeal, contracts have been taken up largely (amounting to 8000 acres), the farmers recognizing that they must co-operate to the fullest extent, though a good deal of their land has already been sown to other crops.

In consequence of the uncertainty with respect to this matter, the National Farmers' Union pointed out that the success of the factories in the future depended upon two points, mainly: (1) The reduction in the cost of manufacture (and they understood that the two factories were prepared to reduce their working costs very considerably); and (2) the handling of sufficient tonnage of beet to enable the factories to keep the overhead charges at the lowest possible figure. With the advantage which will be obtained from the removal of the Excise Duty, the economy in working which they hope to realize, and the price offered for the roots, they hope to operate the factories satisfactorily this year. Circulars issued by both factories with their beet contract forms state that should the result of the year's working be more favourable than anticipated in consequence of the greater volume of beet being supplied and a better price being secured than the values upon which the calculations have been based, then it is the intention of the Companies to take this into consideration when fixing their price for the following season's beets.

Regarding the terms of the contract with the farmers, the price offered is based on the sugar content, namely, 32s. per ton on rail within an area having a a 6s. carriage rate, on a basis of 15·5 per cent.; 1s. is to be added or deducted for each 0·5 per cent. of sugar content above or below 15·5 per cent. A contribution not exceeding 2s. per ton is given to growers outside the 6s. radius, and a premium is promised on roots which are delivered before the 1st of October. The contract admits definitely the principle of advances at certain stages to growers on their crop provided satisfactory field work has been done.

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[1] The cheaper postal rates do not affect the cost of carriage of publications like the *International Sugar Journal*, which remains as hitherto, a rather heavy impost.

Notes and Comments.

The Minister of Agriculture recently announced in Parliament that negotiations were proceeding for the amalgamation of the two factories under British control; and we welcome the movement towards the consolidation of the industry, which means the combination of all the experience acquired to date drawn from both Dutch and French sources with regard to the technical side of the work.

The British Refiner's Position.

Elsewhere we reproduce a long letter which has lately appeared in the *Times* from the pen of Sir ROBERT PARK LYLE on behalf of the British Sugar Refiners Association and in protest against the present incidence of sugar duties. We gladly give space in our pages to their point of view, though we may remark at the outset that while their arguments may be weighty in favour of altering the system of sugar duties and exemptions from duty at *some future date*, their present plea is in the main a case largely of crying out before they are really hurt.

They object to the "staggering amount of protection" which is being accorded to experimental beet sugar production at home, but they omit to point out that this production is, and will be likely to remain for some years to come, no more than 1 per cent. of our sugar production. The experiment itself is more important than the corresponding loss of that 1 per cent. to the refining trade; and since the preference is subject to alteration any Budget day if deemed advisable, it is fairly obvious that the Exchequer can cancel it long before the factories benefited can be shown to be serious competitors of the home refineries; the Exchequer itself will be the first to feel any serious development owing to the corresponding loss of revenue, hence it can be trusted not to let this "staggering amount of protection" develop from a mere percentage into a concrete large sum. So the refiners have no present grounds to worry because a few thousand tons of home grown "direct consumption sugar" miss going through the refineries.

Next the refiners object to the British colonies being able to send us direct consumption sugars under the preference, whilst most of their refining raws are derived from foreign sources and come into this country at the full rate of duty. Even if we grant that the incidence of these duties does favour the maker of British colonial direct consumption sugars, the amount of such sugar being sent to this country is not yet so great as seriously to threaten the position of the British refiner as the final producer of the largest part of the sugar consumed in Great Britain. When it does if ever become a serious competitor, then we have little doubt the Exchequer will be induced to devise some more equitable arrangement. But for the time being the Government are more concerned in fostering the production of sugar within the British Empire than in aiding the refiners to monopolize the trade at home. For this is the real point at issue. The refiners as Sir ROBERT LYLE indicates are out to supply through their own hands all the refined sugar used by this country, and since they seem unwilling to allow that any sugar is fit for consumption unless it has been refined, they want in effect a virtual monopoly of production of every pound of sugar sold in this country; at the same time we have no guarantee that the raws from which they make it will be more, or less, or at all, derived from British grown cane sugars. It is not in the interests of the British sugar producer overseas, nor of the consumer at home, that any monopoly of the means of supply of sugar shall be established; so while the refiners handle already so large a proportion of our sugar (roughly about three-quarters) one is not disposed to cavil if the small amount of direct consumption sugar coming to this country from British overseas sources does find a preference in the incidence of the Customs duties. It is more important at the moment to help to extend the cane sugar industry within the British Empire than to help to extend the refiner's semi-monopoly; the latter is catholic in his choice of raws and, if anything, is more partial to Continental beet than to tropical cane; at any rate it should not be forgotten that before the war the bulk of the sugar refined on the Thames came from Germany and Austria-Hungary.

Sir ROBERT LYLE argues that the refiners suffered from a restricted rate of profit during the war period while the producers made huge profits. But he omits to state that the producers subsequently incurred huge losses which in many instances wiped out a large part of the previous profits. He also refrains from mentioning that while the American and Canadian refiners lost very heavily indeed when the slump came in 1920, the British refiners passed through the ordeal unscathed because the British Government had shouldered this country's liabilities, amounting to nearly 25 millions sterling. We decline to believe that, had there been no Government control, our refiners would have shown a prevision to avoid the consequences of the slump such as proved beyond the acumen of their keen rivals in the States. No! The British refining trade did not do badly during the war and its aftermath, all things considered; if they did not make huge profits, neither did they lose heavily.[1]

We observe that Sir ROBERT LYLE does not mention the severe competition encountered by his interests from the invasion of this country by American refined sugar made from Cuban raws bought below cost price. We should have thought this was a clear case where he might ask for preference for British labour in the shape of his refinery employees, but he prefers to instance the case of Natal sugar (see his last paragraph) though actually the amount of Natal sugar coming to this country must be extremely small, since South African consumption is, if anything, greater than Natal's potential output.

Basis of Payment for Cane.

Natal sugar circles are at present concerned with the problem of finding a more rational basis on which to pay for cane delivered to the factories by the growers, and a Sugar Commission has been directing a good deal of time to investigating the matter. Dr. TEMPANY of Mauritius was invited to give evidence on the systems in vogue both in the West Indies and in Mauritius. A useful summary of his statement is given in a leading article in the *South African Sugar Journal*, from which we take the following particulars.

Mauritius.—In Mauritius the usual payment is in sugar, the planter receiving so many kg. per ton of cane delivered by him, reckoning 1000 kg. per ton. The most usual basis is that by which a planter gets two-thirds of the extraction of the mill in kg. of sugar per ton of cane which he delivers. Thus if the mill takes 10 tons of cane to make one ton of sugar the extraction is 10 per cent.; the planter gets two-thirds of 100 kg., or 66 kg. of sugar for every ton of cane he delivers. This is based on the actual results of the mill.

There is another system in vogue whereby the planter is paid on the extraction of first grade white sugar or alternatively on all sugars, per ton of cane delivered. The actual quantities of sugar paid to the planter under this latter system range from 60 to 72 kg. according to the factory, the districts in which the factories are situated, and the efficiency of the factory. A good many factories are now actually giving 70 kg. of sugar for every ton of cane delivered. The planters are given the alternative of taking the sugar from the factories and carrying it themselves, or if they prefer it, the sugar is marketed with the factory sugars, and brokerage charges, cartage, cost of transport from the factory to the docks, warehouse charges and all other incidental charges are added, and the balance handed to the planter often at the end of the crop. Where this system is in vogue the factories make advances to the planters at the time the canes are delivered, under a weekly arrangement. Sometimes these advances amount to 10s., 12s., or 20s. per ton, or it may be more according to the prices at which the sugar is sold; and when the sugar is sold payment is made to the planter of the balance of the moneys due to him.

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[1] Tate & Sons' dividend for the decade ending 1920 averaged 23¾ per cent.

Antigua.—In Antigua, on the other hand, at a factory run on a semi-co-operative basis, the planters were given payment in sugar, but only received 45 kg. per 1000 kg. to start with. When, however, the season was over and the accounts were made up, the profits were divided into two equal portions, half being credited to the planters (*pro rata* according to cane delivered) and the other half to the shareholders in the mill. The proportion which accrued to the planter varied very considerably because the higher the price of sugar, all things being equal, the larger the quantity of sugar the factory could afford to give away or hand over to the planters. Looking at the matter from the point of view of sugar, as distinct altogether from money, the planter would take so many lbs. of sugar as payment for the cane delivered. Out of the balance there would be set aside a number of lbs. of sugar to pay for manufacturing expenses, in other words the costs of working the factory. The balance left over to make up the 100 per cent., the total sugar, would represent profit. Other things being equal, the higher the profit the less would be the amount of sugar required to pay working expenses. Thus while the quantity of sugar that would go to the planter in the first instance would be a fixed quantity the sugar required to cover working expenses would diminish as the market value of sugar rose. The margin of profit remaining after deducting these expenses would in terms of sugar be greater, and therefore the actual quantity of sugar the planter would get would be greater and greater, as the price of sugar rose.

Comparing the two systems, the Mauritius planter gets more return when the price of sugar is low (up to nearly £15 per ton) but above £15 per ton the Antigua planters received the better return. The West Indian system, according to Dr. TEMPANY, works very well and there are no disputes between factory and planters.

In Natal, according to our contemporary, when sugar is at £18, the planter gets £6 12s. (which is little more than a third), while the miller takes the remainder. It would seem then that in South Africa there is scope for an improvement in the rate of payment for canes when compared with the other instances cited.

Economics of Farm Tractors.

A Cornell University Bulletin on "An Economic Study of Farm Tractors in New York" lays down the following as the chief considerations favourable to tractor operation: 1.—Level topography. Steep slopes are one of the most serious obstacles to successful tractor operation. 2.—The soil should be well drained and reasonably free from stones. Wet spots constitute one of the most serious difficulties for tractors, while the packing of moist soil will often have an injurious effect on crop yields. As for stones, fast ones are a serious disadvantage in tractor ploughing. 3.—Large fields of oblong shape offer the best opportunity for efficient tractor operation. Too frequent turning can be avoided by fields being 100 rods or longer. 4.—A farm or estate should be large enough to keep the tractor busy at profitable work throughout the working season; this helps to reduce working costs. For instance, plenty of belt work should be available when field work is not in demand. 5.—The amount of animal labour dispensed with will depend on whether it is used throughout the season or not. If the greatest pressure of animal work is at harvest time, a tractor will be able to displace few if any of them. 6.—There must be enough capital for tractor and tractor equipment; tractor tools are almost as necessary as the tractor itself. 7.—Mechanical ability and experience are essential to successful traction operation; but almost any intelligent person familiar with the essentials of gas engines or farm machinery can master the fundamentals of tractor operation. 8.—The saving of man-labour by tractors is usually of greater importance than the saving in animals. Where labour is scarce the tractor has important advantages. 9.—The relative costs of animal food and tractor fuel should not be lost sight of.

Mr. Geoffrey Fairrie and Direct Consumption Sugar.

A Few of His Inaccuracies corrected.

On April 12th Mr. GEOFFREY FAIRRIE, of Liverpool, delivered at Halifax a lecture entitled "The Production and Consumption of Cane Sugar," in the course of which[1] he made the following statements:—

> "There are certain yellow or brown sugars made in the tropics and sold here under various names, but collectively known as direct consumption sugars. . . Actually the sugar is imported from the plantations into consumption without having been cleansed and purified in a refinery. Compared with refined sugars, these inferior grades are obviously unclean. A careful investigation of the two kinds of sugar proves how widely they differ. A sample of white refined sugar can be dissolved in water, and allowed to stand, when a careful search, even with the microscope, will reveal no foreign matter in the clear and colourless solution. A scientific examination of high-grade direct consumption sugars has recently been made by one of the most eminent authorities in the country, with the following result. The sugar was dissolved, and a muddy sediment appeared at the bottom of the vessel; whilst, instead of the solution being bright and clear, it was cloudy. An examination of the sediment revealed sugar cane fragments, amorphous matter, and miscellaneous debris. By further research, bacteria, fragments of living mould, mould spores, and dead yeast cells were detected. . . . There are also certain direct consumption sugars, known as 'plantation whites,' . . . In these sugars, which are very nearly white, the colouring matter has been masked, but not removed. . . ."

Once again, therefore, the old controversy regarding direct consumption sugars *versus* refined is renewed, this time with Mr. GEOFFREY FAIRRIE as the apparently self-appointed protagonist for the re-melters. One will remember the controversy that took place some years ago in the United States, when the refiners in that country boomed the alleged presence of *Acarus sacchari*, microbes, and dirt in plantation white sugar for all it was worth, many ridiculous arguments being advanced on both sides. At the outset of this article, let us say that our attitude towards the question is not one of bias to direct consumption sugars as compared with refined; but rather to pronounce as unprejudiced an opinion as possible on the technical evidence put forward by both controvertists, and especially to correct any misleading statements made by either party.

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[1] Reported in the *Halifax Courier and Guardian* of April 13th, 1922.

ALLEGED "MUDDY SEDIMENT."

On this occasion we consider it our duty to call attention to certain gross misstatements made by Mr. FAIRRIE in his Halifax lecture. The first of these concerns the assertion that direct consumption sugars on being dissolved in water leave a "muddy sediment," an assertion which is altogether inexact, and one we think which would hardly be supported by any chemist attached to the refining industry. Correspondence which has passed between us and Mr. FAIRRIE has elicited the fact that the "high-grade direct consumption sugars" concerned were: Demerara crystal sugar; Jamaica crystal sugar; and crystallized Trinidad, that is, the yellow crystal sugars which are so much appreciated in this country on account of their fine flavour and pleasing appearance. We have examined many samples of such sugars in the laboratory, and have found that, although they do not give a clear solution, as do most refined grades, the amount of insoluble matter present in them is really comparatively small, and can in no wise be termed a "muddy sediment." We have invited Mr. FAIRRIE to send us samples of these sugars, in order that we may determine the actual percentage of insoluble matter they contain, but this gentleman has not responded to the request, from which circumstance the reader may make his own inference. In the manufacture of these yellow crystal sugars, it is well known to most people that the process of clarification must be performed with great care, in order to eliminate impurities (including insoluble matter) as fully as possible, otherwise the appearance of the product suffers.[1] Even in Cuban raw sugars, in the manufacture of which much less attention is paid to clarification, the insoluble matter is reported to average about 60 mgrms.,[2] and in some samples about 30 mgrms. per 100 grms. of the sugar, that is 0·06 and 0·03 per cent., which can hardly be regarded as constituting a "muddy sediment."

PRESENCE OF BACTERIA, MOULDS, ETC.

We next consider the statement regarding the presence of "bacteria, fragments of living mould, mould spores, and dead yeast cells," alleged to have been found in the yellow crystal sugars by "one of the most eminent authorities in the country," whose name Mr. FAIRRIE prefers not to divulge. Now the fact regarding this point is that the micro-organisms named are doubtless present in both yellow crystals and plantation white sugars; but at the same time it occurs to one to enquire whether refined sugars are actually quite sterile. Careful investigations carried out during the past few years[3] have shown that in the manufacture of raw and direct consumption sugars the result of the clarification process is to render the juice practically sterile, but that later when the massecuite is exposed to the air in the centrifugals, re-infection occurs, due no doubt to the air with its floating micro-organisms (that is, bacteria, moulds, and yeasts) being sucked against the crystals during their very rapid revolution. If later steam is used for covering in the centrifugals, then practically all the bacteria and moulds are eliminated, as has been recently proved,[4] though subsequently during cooling some re-infection (though probably little) would occur. Very much the same conditions must obtain in the refinery. During the clarification operation there, that is, treatment in the blow-up and passage through the char, the liquors are probably rendered sterile, but it is likely that during swinging, and also later when cooling after leaving the granulator, some re-infection may occur when air comes in contact with the crystals. At any rate, the fact that refined sugars as purchased in the market to-day are quite sterile remains to be proved; and possibly it would be found if a bacteriological examination were made by an independent authority (preferably not an anonymous one) that the number of micro-organisms per grm. present in high-grade plantation white sugars which have been steam-covered is not much greater than in the average refined, although in both cases the "count" would probably be very small. In any event, direct consumption sugars are not to be condemned because they contain a few non-pathogenic organisms, otherwise one would have to disparage a number of excellent products which are largely consumed at the present time, and beer is one that may be given as an example. Yet better reasons will have to be found before the British workman will be convinced that he should adopt the doctrines of the Pussyfoot Party.

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[1] One may refer to Jones and Scard's "The Manufacture of Cane Sugar" for an excellent account of the manufacture of these sugars. [2] *La. Planter*, 1921, 67, No. 23, 366.
[3] *I.S.J.*, 1919, 465. [4] *I.S.J.*, 1920, 591.

SUGGESTION REGARDING NATIVE LABOUR.

But there is another statement made by Mr. FAIRRIE not long ago about which we should like to make a few remarks. In one of his lectures delivered at Bradford on December 7th, he is reported to have said:—

> "When it is remembered that the process of manufacturing raw sugars abroad is carried out largely by natives whose habits are not altogether unobjectionable and characterized by cleanliness, this thought together with the consideration of the impurities enumerated above is conclusive evidence that raw sugar is not a fit article for human consumption . . . . . ."

This we regard as an altogether deceptive and mischievous statement to issue to the public,[1] the natural deduction from which is that direct consumption sugars (whether yellow crystals or plantation whites) are likely to be unwholesome when native labour is employed in their production. Mr. FAIRRIE must know that in the modern cane factory making sugar for export to this country the native workman has no more to do with the actual handling of the material from start to finish than the white labourer in the Fairrie refinery at Liverpool. Then in regard to *Acarus sacchari*, which in this Bradford lecture is declared to be one of the terrors of raw sugar, Mr. FAIRRIE should also know that this mite is hardly to be found in modern raw sugars, being present as a rule only in the syrupy low grades, the amount of which now imported into this country is comparatively insignificant. Probably no one is better entitled to express an impartial verdict on a point such as this than Dr. C. A. BROWNE, Chemist-in-Charge of the New York Sugar Trade Laboratory, whose opinion was recently expressed[2] to the effect that *Acarus sacchari* "seems to be largely absent from modern centrifugal sugars." It is certainly never to be found in yellow crystals, while its existence in plantation whites is no more possible than in refined sugars.

In reference to these lectures delivered by Mr. FAIRRIE, we believe the impression obtainable from them by the public to be an altogether misleading one; and it would be of interest to know to what extent his efforts to decry direct consumption sugars are approved by the refining industry as a whole. Furthermore, it seems pertinent to raise the point whether Mr. GEOFFREY FAIRRIE is best qualified to express an opinion on this question, which after all is one that calls for the judgment of the chemist and bacteriologist.

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[1] Originally it appeared in a pamphlet entitled "Report on the Direct Consumption of Raw Sugar," which was issued in this country during the war. It bore no name, either of author or publisher.

[2] Paper read before the American Chemical Society, Sugar Section, September, 1920.

Summing up this matter regarding the food value of yellow crystals and plantation whites, we consider that there are no grounds whatever for believing such sugars to be in the least degree less wholesome than refined sugars. These palatable products have been consumed for many years past in immense quantity in Louisiana, South Africa, Mauritius, India, Java, and in other countries; and no valid complaint regarding their suitability as a food has ever been advanced against them.

British Refiners and the Preferences on Home-Grown and Colonial Sugar.

The following letter appeared in the *Times* last month and is reproduced here as giving the views of the British refiners on the effects of the preferences accorded to home-grown beet and colonial cane sugar in the Customs and Excise tariffs.

HOME-GROWN SUGAR.

English Refiners' Position.

To the Editor of the Times.

Sir,—While newspaper correspondence and general propaganda have been carried on during recent months by those interested in home-grown sugar, and, in a lesser degree, by the sugar producers of our Colonies, the sugar refiners of the country have refrained from making their voices heard; not that they have not a good case for consideration by the Government and the public, but because they hesitated to put a spoke in the wheel of an infant industry in which some optimists had invested money. Now, however, that the Minister of Agriculture has announced in the House of Commons that "the Government has decided that in view of the exceptional circumstances of the new industry of sugar beet, and the condition of unemployment in this country, no Excise Duty should be charged on home-grown sugar," it is only right and proper that the silence should be broken and the case of the sugar refiners put before the public. Will you, therefore, kindly grant me space to state this case as shortly as possible?

The sugar refining industry of the United Kingdom is an old and honourable one. It flourished in the middle of last century, when there were many refiners in each of the ports of London, Liverpool, and Greenock, and others in Glasgow, Bristol, Leith, Plymouth, and Dublin. Then came the ruinous competition developed under the unfair bounty system adopted by France, Germany, Holland, Belgium, Austria, and other Continental sugar-producing countries. The weaker and less well managed of our refineries gradually went down, until in the early days of this century, when the bounty system was abolished by the Brussels Convention in 1903, there remained in active operation only 12 refineries, and their output represented but a small proportion of the sugar consumed in this country.

Since 1903 the surviving refiners, freed from the unfair bounty-fed competition, have been able to hold their own and to increase their output, and in 1914 they were supplying a much larger proportion of the sugar consumed in this country than was the case in 1902.

On the outbreak of war the sugar refining industry was taken under Government control, and that control continued until February 26th, 1921. While other manufacturers, merchants, shipowners, and the sugar producers of the Colonies were free to make, and did make, huge profits, the refiners were restricted to a rate of profit per ton based on the average profits of the three years immediately preceding the war. Owing to shortage of labour and other causes some refineries could not always reach their pre-war output, and so, at times, did not reach their pre-war profits. The refiners did not complain. They worked hard and loyally with and for the Royal Commission on the Sugar Supply, and the importance of their services has been acknowledged by that body.

Owing to the present enormous duty, the consumption of sugar in this country is much less to-day than it was in 1913. The home refiners can supply all the refined sugar required by the nation, and, should the duty be lowered and consumption increased, the refiners would willingly increase their plants to meet the increase, provided they were given some assurance that they will receive fair and equal treatment with the other sugar interests of the Empire.

To-day Canada, the West Indies, Demerara, Natal, and Mauritius can, and do, send direct-consumption sugars to this country to compete with the home refiners under a preferential tariff that gives the former an advantage over the latter of over £4 per ton. The advantage enjoyed by the beetroot sugar factories at Kelham and Cantley is greater still, and the latter is, or was, owned largely by Dutchmen. Now it is announced that the Government propose to grant entire freedom from Excise to home-grown sugar. This means that the factories named will enjoy, so long as the present rates of duty hold, an advantage over the British sugar refiner of £25 13s. 4d. per ton, or 2¾d. per lb., an unprecedented and undreamed of and staggering amount of protection.

Personally, I do not believe that sugar produced from the sugar beet in Europe will ever again be able successfully to compete with cane sugar as produced in Cuba, Java, or Peru. But if the Government and Parliament wish to continue the costly and doubtful experiment of producing sugar at home, let them do so in a way that does not mean the extinction of an old and, nowadays, firmly established home industry. The way to do this is to grant whatever preference is deemed necessary on raw sugar only—say on sugar not over 97° polarization or 94° net analysis. Such sugar would be taken by the refineries at its full world's market price, the cultivation of the sugar beet would be encouraged, less capital would be required in the factories, and the refiners would not suffer. Let it be remembered also (and this is a point that has evidently been overlooked by the Minister of Agriculture and others) that every workman who finds employment by the production of white sugar in a home beet-sugar factory throws out of employment one or more of his fellows in the refineries of London, Liverpool, or Greenock.

The above is also the method in which preference should be given, if it must be given, to the Colonial sugar producer. To give him a preference over the British refiner on direct-consumption sugar simply means encouraging Colonial capital and labour (often coolie labour) at the expense of home capital and home labour. While Natal sugar is to-day enjoying in our market an advantage over the product of the British refiners of over £4 per ton, the Government of the Union is considering how best to exclude from South Africa the small quantities of our products that find their way there!

I am, yours faithfully,

ROBT. PARK LYLE, Chairman, Tate & Lyle, Limited,
21, Mincing Lane, E.C. 3. President, British Sugar Refiners' Association.

[*** We discuss this letter in our *Notes and Comments.*—ED.]

It is pointed out[1] that the former interdependence of the refiner and the raw sugar producer is diminishing in America, since during recent years refiners have acquired large interests in Cuban factories; while, on the other hand, some raw sugar producers have endeavoured to engage to some extent in refining. Thus, the American Sugar Refining Co. owns seven refineries and two raw sugar centrals, Cunagua and Jaronu. Atkins & Co., Ltd., have connexion with the Pennsylvania Sugar Co.'s plant in Philadelphia, and control the Cuban centrals Punta Alegre, Florida, Soledad, Trinidad and San Augustin. The Cuban-American Co owns the Gramercy and Cardenas refineries, and is affiliated with the National and New York refineries, while it owns centrals Mercedita, Tinguaro, Unidad, Constancia, Delicias and Chaparra. The Cuba Cane Sugar Corporation owns 16 factories, and is affiliated with the W. J. McCahan refinery. The United Fruit Co. owns centrals Boston and Preston, and the Revere refinery of Boston. The Warner Sugar Refining Co. owns the Warner refinery at Edgewater, and owns or controls centrals Miranda, Palmarita, Gomez Mena, and Amistad. Lastly, the Hawaiian sugar planters own certain amounts of stock in the Western Sugar Refinery at San Francisco and the California & Hawaiian Sugar Refining Co at Crockett, California.

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[1] *La. Planter*, 1922, 68, No. 5, 67-69.

Fifty Years Ago.

From the "Sugar Cane," May, 1872.

This issue of our predecessor opened with an article by EUGENE FELTZ on the difficulties occasioned by the presence of "glucose" in sugar manufacture and refining. He discussed at some length the danger of working with a marked alkaline reaction in the production of colonial sugars, giving particulars of a number of experiments upon which his conclusions were based. In general, these demonstrated clearly the influence of heat and alkalinity upon the production of what are now known as "glucose decomposition products," though his tests lacked precise information regarding the degree of acidity or alkalinity employed, terms such as "the solution was rendered alkaline by a little lime," and "the solution was made slightly acid," being used throughout. Nevertheless, the article has still a certain interest, and contains some facts which are utilized in practice at the present day.

Another paper of interest to the chemist was one by T. L. PATTERSON, of Greenock, entitled "Some Experiments with Fehling's Solution," the principal point in which was the great influence of the amount of alkali present. In fact, one of his conclusions was that "Fehling's solution has no definite grape sugar equivalent depending upon the weight of cupric oxide it contains, but that its glucose destroying power varies directly (within certain limits) with the quantity of alkali present." One of his experiments showed that when sodium hydroxide is in great excess a comparatively large amount of invert sugar solution is required to effect complete reduction. PATTERSON prepared his Fehling's solution by the old formula, according to which both the copper sulphate and the alkaline tartrate constituents are made up at once together. He studied the decomposition of the mixed Fehling's solution, finding that in a bottle partially filled with this mixture all the oxygen is absorbed from the air in the bottle in the course of time, the alkalinity meanwhile decreasing owing to the decomposition of the tartaric acid into other acids of greater acidity. However, in preparing Fehling's solution at the present time the practice of dissolving the copper sulphate and the alkaline tartrate ingredients separately, and mixing only before use, is very general, so that now these results have less importance than they had at that date.

A letter was published by ALFRED FRYER, who at that time was visiting Guadeloupe, on the Elephant cane, which M. LAURIOL was then trying to cultivate in that country. It was described as dark purple without streaks, the diameter of the stalks being 2⅝ in., and the height 10-12 ft. It was said to yield juice having a density of 10° Bé. (nearly 18° Brix). Eleven plants had been received from Cochin China and cultivated, and it was intended to distribute cuttings among planters in different parts of the Colony.

Two patents, both French, were noticed. The first[1] concerned a method of washing raw sugar, according to which the crystals were mixed with water or syrup in a vessel provided with a stirring apparatus, and the mass thrown into vessels having the shape of truncated cones, air being drawn through in order to effect "clearance." The second patent[2] related to "an apparatus designed to divide and break up the mass of sugar which proceeds from the crystallization tanks to mix it with water, syrup, or steam, and send it into the centrifugals in a continuous stream without having occasion to empty it into the machines by means of buckets, as is generally done."

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[1] No. 90,387.

[2] No. 8999.

Selection of Varieties in Cane Cultivation.[1]

This paper by F. S. Earle is the last of a series of three published in the same Journal.[2] In it he summarizes all the information he has collected regarding canes grown in Porto Rico, but besides this he presents his matured opinion upon the whole subject of the classification of sugar canes and, as is usual with him, treats in separate sections of such subjects as he considers to be connected with his main thesis. It is with this adventitious matter that we propose to deal in the present note.

It is a fortunate circumstance that the author has been able to publish this long paper of 141 pages before taking up an entirely new line of work, in which we are told that the opportunities for writing will be much restricted if not entirely suspended. Earle's work on sugar cane and other crops[3] has always been distinguished by broadness of view and singular conciseness and clarity of expression and if, as appears to be the case, his disappearance from among the contributors to the *Porto Rico Journal of Agriculture* is connected with the incessant changes of personnel so characteristic of the Department of Agriculture in the island, it is a serious indictment of the futility and viciousness of that policy.[4] Both of the other papers of the series have been noted in this Journal. From the first we extracted a note on the "Question of Policy in the Selection of Cane Varieties,"[5] and the second received a longer notice under "Recent Cane Agriculture."[6] In the present paper the first 40 pages are devoted to various subjects which, in their turn, have been more or less the questions of the hour in cane cultivation and, although obviously dominated by his intimate knowledge of conditions in Cuba and Porto Rico and perhaps primarily intended for Porto Rican readers, the summaries given are worthy of the attention of a wider circle. These then we shall pass under review, although the author's habit of using few unnecessary words makes abbreviation difficult and often does not do full justice to his line of argument.

Foreword.—The importance of the selection of the proper variety for each tract, if not for each field on an estate, is now generally conceded in the industry. But the author points out that little has been done to put it into practice. The average planter only too often plants his favourite cane in all kinds of soils and under all sorts of conditions, while in Porto Rico it is the almost universal practice to plant a miscellaneous mixture of canes in the same field. Besides the question of obtaining a crop of evenly maturing canes, this mixing is of specially serious import as regards pests and diseases in that the different kinds vary greatly in their resistance. "This careless custom is costing Porto Rico literally millions of dollars annually." In every important sugar cane growing country in the world, the industry has been threatened at one time or another by the sudden appearance of some plague, and aside from strictly preventive methods no practical remedy is known for any sugar cane disease, except that of substituting some more resistant kind. When once this fact was appreciated, great collections began to accumulate in the experiment stations of many countries and exhaustive trials were commenced with these. Then came the discovery of the fertility of cane seed and the interest in the new kinds thus produced relegated the older kinds into the background before their ranges of adaptability had been thoroughly investigated or their botanical characters determined. This was doubly unfortunate, both because no new kind has yet been discovered of equal yield and richness with the old canes which had dominated the cane-growing world for so long, and also because the old forms naturally form the basis on which the new kinds have been raised.

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[1] "Sugar Cane Varieties of Porto Rico," II. F. S. Earle. *The Journal of the Department of Agriculture of Porto Rico*, Vol. V, No. 3, July, 1921, (issued 1922).

[2] "Sugar Cane Varieties in Porto Rico." Vol. III, No. 2, April 1919, and "An Annotated List of Sugar Cane Varieties." Vol. IV, No. 3, July 1921.

[3] For an example see "Southern Agriculture." F. S. Earle. 1908

[4] *I.S.J.*, 1921, p. 610. [5] *I.S.J.*, 1921, pp. 16-17. [6] *I.S.J.*, 1921, p. 450.

Deterioration of cane varieties.—EARLE is a convinced believer in the old varieties and argues with great force that it is the soil that has deteriorated and not the varieties themselves. He claims that the Otaheite when grown under the same conditions as it was a hundred years ago, as in some parts of Cuba, does not appear to have changed in its essential characters and gives the same fine yields as it did of yore. It is a cane adapted to a narrow range of conditions, namely, a well aërated soil abundantly supplied with vegetable matter. When it became necessary to plant it on soils compacted by long usage and with the humus and other elements of fertility partially exhausted, it failed miserably, as the root system was not adapted to such conditions. The soil has deteriorated and not the Otaheite, and it affords a striking example of the necessity of selecting varieties adapted to the particular conditions under which they are grown. It was replaced by the Cristalina hailing from Java, which had long been grown side by side with the Otaheite but never purposely planted because the juice was not so easy to manipulate, but which proved to be less narrow in its range of suitable conditions and retains its position to this day as the most widely distributed general purposes cane. It too is now being accused of deteriorating and in places is being replaced by forms with still wider adaptation or, as we say, greater resistance, and so the history repeats itself, the soils of the sugar world gradually but surely becoming worse instead of better through the extension of the industry to lands less suited to cane growing and the wearing out of the old time fertile soils. Surely this is an argument for the intensive cultivation which we have of late repeatedly upheld as the crying need of the hour in the present crisis.

The possibility of improving existing varieties through the selection of bud variations.—Although it might appear from the previous section that EARLE is of opinion that sugar cane varieties propagated vegetatively are immutable, he emphatically states that this is by no means the case. "Change is the universal law of living things. . . . . No two buds, even of the same shoot, will produce absolutely identical plants." Sporting, a pronounced form of bud variation, is well known in the sugar cane, as well as in other plants, and this phenomenon is specially common in the tropics. Among the well known colour sports the author points out that at least two ribbon canes have thus arisen from the Otaheite itself. He further draws attention to the idea often urged by writers on the subject that other bud varieties probably occur which are only not known because of their less obvious character, and develops two lines in which improvement has been sought by what is practically bud variation, increased richness in the juice and greater vigour and resistance to specific diseases. The former had a great vogue at one time and he singles out KOBUS' Java studies as specially worthy of mention. This worker however differed in his method from the rest in that he depended on mass selection, taking the heaviest canes in the field which he also found to be the richest in juice. But richness of juice is influenced by too many local factors, and nothing appears to have come of all this work, although KOBUS claimed that he met with considerable success. The author considers that the problem is by no means proved to be insoluble, though difficult, and that it is worthy of further careful and continued effort.

Selection for greater vigour and resistance is much easier, and is to be prosecuted among those few flourishing clumps with which everyone is acquainted in heavily diseased fields. **Earle** refers to Java work in attacking the sereh problem and states that this is the only published instance, but similar work was done at the Samalkota Sugar Station in India, where independently the same method was applied with regard to red rot,[1] and a diligent search would doubtless reveal many other cases. The results have been disappointing, and the author details his various attempts in Cuba and Porto Rico, one and all of which were frustrated by circumstances over which he had no control, and he concludes that this attractive field still remains open for future investigators. A great number of such sports have been marked down at different times as producing new varieties of promise, and at the present moment an ambitious scheme is actually being carried out, as we noted last month, in Hawaii where **Shammel** (whose Citrus work **Earle** mentions) is leading a campaign for increasing the production of sugar per acre in those islands.

The flowering of the sugar cane.—This well known phenomenon was studied by some of the older writers who were even led to make use of it in their attempts at classification. **Earle** points out that this has proved of little practical value in that many kinds will flower in some years and situations and not in others, and states that the reasons for flowering are little understood. By observing that the canes flowered in Cuba in November and December, dry months, it was held by some that moisture was the determining factor, till it was noted that in Porto Rico the canes flowered in the same months although these were wet. He rightly states that age is a determining factor, but has not followed recent work in India on the subject where considerable progress has been made. Further, it has there been demonstrated that, given the necessary conditions, some classes of Indian canes flower freely, while, under no known conditions, have others been induced to do so, and all stages have been noted in the groups of canes between these two extremes. The differences between the tropical canes are less striking, but there can be no doubt that the flowering of the cane is a botanical character, which on occasion may prove very useful for the purposes of classification. **Earle** also approaches the question of the influence of arrowing on the richness of the juice and adduces additional evidence that the common belief in his islands that the juice is poorer after flowering is incorrect, by a simple analytical experiment. Nineteen pairs of canes of the same age and plots were analysed, and the table of results is useful as so few have been published. The following are the average results of the experiment.

	EXTRACTION.	BRIX.	SUCROSE.	REDUCING SUGARS.	PURITY.	FIBRE.
Arrowed	66·11 ..	18·05 ..	15·05 ..	0·692 ..	88·19 ..	12·63
Non-arrowed ..	68·63 ..	17·05 ..	14·78 ..	0·955 ..	86·15 ..	12·68

The author traces the common belief referred to to the fact that arrowing frequently takes place sometime before harvest when, in the event of rain moistening the soil, shooting takes place with deterioration of the sugar content in the arrowed canes.

The Ripening of the Cane.—Richness of juice depends more on maturity than on the variety grown, for a poor cane when ripe will have more sugar in it than a rich one not yet mature, a further cogent argument against the mixing of different varieties in the same field. After a cane has reached its optimum deterioration takes place, but at a very different rate in different kinds and under different external conditions. Thus Otaheite "goes to pieces" at a great pace while Cristalina is much more stable. The factors mentioned by the author as of influence in the ripening of the cane are as follows. *Soil moisture:* the juice attains its highest sucrose content when growth ceases, and this cannot occur when the soil is still wet. Thus the richest juice is invariably met with in countries where there is a markedly dry season. *Temperature:* cold assists ripening while heat retards it because of the stimulus to growth. The *character of the soil* has marked influence, the canes ripening more quickly on porous, well drained land and in hill tracts than on low-lying retentive soils. *Fertilizers*, as is well known, may be used with great effect and similarly the *chemical composition of the soil* is of importance. Thus in new land, such as that of virgin forest, the first crops usually yield canes with low sucrose and the optimum is frequently not reached till the third or fourth harvest. Hence it is advisable to plant such varieties on it as Yellow Caledonia, B 3412 and Cavengerie, which give large tonnages of canes with poor juice, or to put B 208 in poor worn out lands. *Cultivation methods* are of influence in certain cases, as instanced by the trashing of canes in some localities although this has not been found of advantage in Porto Rico. Tillage, while inducing growth, ceases when the canes close in and has therefore little permanent effect on the maturing of the crop.

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[1] Scientific Report of the Samalkota Agricultural Station, 1905-6, pages 31-33. C. A. **Barber.** Department of Agriculture, Madras, 1907.

Ripening is often indicated by a definite change in colour, green tending to become yellow and red or purple becoming duller, brownish or even olive green. The leaves become paler and less erect, and arrowing while not of necessity occurring when the cane is ripe for harvest, is an additional indication that maturity is approaching. The *colono* system tends to crushing the canes when unripe, and the only sure method is to call in the aid of the chemist with rough preliminary tests of the composition of the juice. The importance of reaping the canes as near as possible to full maturity may be judged from the fact that in a 40-ton crop an increase of one per cent. of sucrose in the juice will mean 600 lbs. of sugar obtained. There is a good deal more to be said on this subject, and the author might have added a note on the fact that in each clump it has been demonstrated that at no time are all the canes ripe together because of their differing age and order of branching,[1] which suggests that the correct point at which harvest should take place becomes still more a matter for experienced expert judgment.

Deterioration of the Cane.—This important subject is briefly treated. It depends primarily on the weather, frost and wet being especially effective, but also on the pests and diseases prevailing and markedly on the variety grown. EARLE considers it remarkable that so few cases have been recorded of systematic preliminary analyses throughout the period of growth and refers only to a paper by COLON on Yellow Caledonia in Porto Rico. It is certain that a very great number of other references might be added by diligent search, and we merely note here the numerous cases dotted over Indian publications and the recent analyses month by month given in the latest Report of the Queensland Sugar Bureau. It is particularly important that the matter should be brought to the notice of the larger islands in the West Indies for it is mentioned that in Cuba and Porto Rico a week is often allowed to elapse between cutting and milling, whereas the author lays it down that, while they can be safely allowed to lie over for two days, a further delay causes rapid change and loss of sugar. Burnt canes on the other hand, whether intentional or accidental, must always be treated at the earliest possible moment.

C. A. B.

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[1] Studies in Indian Sugar Canes, No. 4. "Tillering or Underground Branching." C. A. BARBER. *Memoirs of the Department of Agriculture in India.* Vol. X, No. 3, July, 1919, pp. 91–95.

The Sugar Industry of the Crown Colony of Fiji.

By THOS. J. McMAHON, F.R.G.S.

Colonial office rule has not generally the reputation of being either popular or progressive in any of the British Colonies. This rule may be termed an experimental rule, and this is abundantly evident in the serious attempt being made at the present time to give Indians equal rights with the white settlers. The whites are protesting strongly against racial equality with the Indians in their low moral standard, and their strange and often disgusting customs, making them uncompanionable to the whites.

Colonial office rule has scored in the Fiji, but the credit must be given to many wise administrators and their officials, in their interpretation of the rule. Undoubtedly a sane balance has been maintained in the Fiji islands giving the white settlers every scope for their enterprises, while adequately protecting the native race. The Crown colony of Fiji has made remarkable and even conspicuous progress to-day, owing to the opening of the Panama Canal; the Fiji islands have become the half-way house, as it were, of the South Seas, and this at once gives the group a most important commercial standing. Had it not been for the progressive policy of the Fiji administration, mostly official, and the outstanding abilities of officials, the group would not have been ready to take its rank and place in the commercial advancement of the Empire. Colonial rule has gained the credit, but it has been and is official commonsense that has made Fiji.

The group consists of 250 islands, with a total area of 7500 square miles. There are two very large islands and many small ones. Viti-levu is the largest, 4000 square miles,[1] and it is the island with the most settlement, and the centre of the great sugar industry. The group is divided into wet and dry areas, the wet never exceedingly so and no hindrance to development, and the dry never subject to drought. Climatically the Fiji islands are reckoned the healthiest in the South Seas, the death-rate being the lowest in the world. The climate is influenced by the towering mountains of the two big islands, Viti-levu and Vanua-levu. Malaria and other tropical ailments are quite unknown. British settlers have lived to 80 and 90 years of age, after 50 years of residence, and been active to the last.

The islands are remarkable for their many useful harbours, and the navigable, calm waters within the reef areas which practically surround the various islands of the group. The harbour of Suva, the capital and chief seaport, is easily accounted one of the safest and deepest of the Southern Hemisphere. This harbour is like what Singapore is to the East, the meeting-place of all South Pacific shipping. At present it is constantly filled with the ships of all commercial nations. The rivers of the two big islands are notable features; they are wide, long, deep, and of the greatest commercial utility. They run through the chief centres of the sugar industry. The river Rewa is called from its mighty size the Missisippi of the South Seas.

Suva, the capital, is an up-to-date city in every respect, with its water supply, electric lighting, and its vigorous municipal management. It is the centre of a trade worth five millions sterling a year. The population of the Fiji islands is 4000 whites, 85,000 Fijians, 61,000 Indians, 3000 half-castes, and 5000 Chinese, and other Asiatics. It was in the year 1874 that the Fiji islands were ceded to the British, and when British administration began its successful policy of progress.

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[1] Or say rather less than the area of Jamaica.—[ED., *I.S.J.*]

Prior to that the government was native, with a native king, Thakambau by name, an interesting and altogether remarkable person. From a mere petty chief of a very small island, Thakambau with a band of warriors, giants in stature like himself, conquered the Fijis and was proclaimed king. He had a great deal of shrewdness, and encouraged the white settlers, the first being British coming from Australia, then followed other Britishers and several Americans. While the revenues of the South-sea kingdom were ample to meet the extravagances of the king, he lived in regal splendour, and the royal favour was freely bestowed upon the white settlers. But when bad times came, and native government was not instrumental to commercial progress, and the whites attempted to set up a government on the constitutional lines of England, King Thakambau objected. Trouble between the natives and the settlers was now constant. The king and the American settlers fell out, and some of their property was destroyed. They made a claim of 40,000 dollars, and the American Government sent a warship to enforce it. For a few months it looked as if the Fiji islands were to become American. In the height of the quarrel the British missionaries appealed to the king to invite the English Government to protect and administer the islands. The American Government suddenly determined not to press its claim, the group passed to the British, and Thakambau retired to the small island of Bau, on a princely pension.

Development in the Fiji islands is most impressive, both in quality and extent. The coast-line of the islands, large and small, is an almost unbroken area of settlements, sugar fields, and coconut plantations. On the rivers there are vast areas of cane and miles of banana cultivations. In the hill lands and the valleys of the rivers there are magnificent pasture lands, and herds of cattle are increasing rapidly. Dairying is fast becoming one of the most thriving industries. In the sugar centres one is greatly amazed at the number, size, and equipment of the sugar mills, in every accessory acknowledged as some of the finest of the sugar world. There are hundreds of miles of excellent quality light railways, with rolling stock of the best English makes. The Colonial Sugar Refining Company has 300 miles of permanent way, with 100 miles of movable rails. Great steel and coral concrete bridges span the rivers. Motor traffic is wonderful in number and variety by road, rail, river, and harbour.

It is the sugar industry of the colony that commands especial attention, inasmuch that it is so predominant, so scientific in management, so thoroughly successful. According to expert opinion every acre of land of Fiji is capable of sugar cane cultivation. The ocean foreshores, the river deltas, and low-lying swamp areas can be reclaimed, and by suitable draining can grow sugar in very profitable quantities ; this is being amply proved. Both in the wet and dry areas of the colony sugar is doing remarkably well, producing on the average about 30 tons of cane to the acre; on the river lands this is often increased to 60 tons. At present there is estimated to be some 150,000 acres under cultivation, and these acres are considered to be equal in sugar producing to the best lands of Java and Hawaii—that is, with intense cultivation, they could give 4 to 5 tons of sugar to the acre. There are six sugar districts of Fiji, each having its mill. The mills have capacities varying from 15,000 to 35,000 tons per annum. The big mill of the Colonial Sugar Company at Lautoka is very fine and complete in every way.

For many years the white planter of Fiji did well, but latterly the sugar plantations have been gradually falling into the hands of Indians. The decline of the white planter is due to two causes: labour troubles, and the very good price the Indians are always ready to give in purchasing lands. Practically, then, the majority of planters to-day are Indians, an evidence of their prosperity. In many instances the sugar companies lease lands on easy terms to Indians; indeed, the companies have done most generous things in helping them. The inexperienced Indian planter is practically taught his business by the experts of the companies. Furthermore, the companies often, nearly always, provide the capital for the Indians to start; and they stand by them until they are assured of success. The companies provide horses, mules, or cattle for the planters, as well as agricultural implements. At harvest-time temporary rails are laid down to convey cane to the main lines and thence to the mills. In helping this Indian settlement, only very recently the Colonial Sugar Refining Company handed to the Fiji administration a cheque for £100,000.

There are species of true sugar cane in the Fiji Islands. One "Dovu," as it is called by the Fijians, grows wild, and the natives are fond of chewing it, and sweetening their foods with it. There is another called "Vico," but it is of little value. Neither has modern commercial qualities to be profitable, and so has never been used. The canes cultivated are Badila, Malabar, Rose Bamboo, and Striped Singapore. Cane was first introduced in Fiji in the year 1872, by a West Indian planter named Lester Smith. For his enterprise he was rewarded by the British Government with a handsome bonus. The first successful mill was operating in 1882.

To make the sugar industry profitable it must be carried on in an extensive manner; the small areas of cane, and the small mill, have never been successful or serviceable in Fiji. The industry has been put on a very solid basis, but for the last ten years strikes and other labour disturbances have done much to hamper progress. The Fijians until very recently have not assisted in the progress of the industry, or for that matter in any enterprise in Fiji. They are a wealthy people, and independent of work. However, the younger generations are getting away from many of their old customs, particularly Communism, and in their modern civilization and education are eagerly keen for the white man's trades and enterprises. This factor is all important at the moment in the unrest and dissatisfaction of the Indians. The Fijians are a fine, hefty race, and will undoubtedly in the future be of material strength to the industries of the colony.

Some 48 years ago by the energies of a progressive governor of the Fiji islands, Indians were introduced to help the then flourishing cotton industry of the colony. When sugar was found to be especially suitable to the possibilities of the Islands, Indians in thousands flocked to the aid of the sugar companies. For 38 years they were a happy and contented people. Then agitators of the Ghandi class found entrance to Fiji, and stirred up the Indians against the indenture system then in vogue, which by the way up to then appeared perfectly satisfactory to the Indians. Indenture has been abolished, and the Indians, minus the recognition of racial equality, have every right and privilege of the whites. They still refuse to be satisfied, and by irritating strikes, carried out fanatically as "religious strikes," have done considerable harm to the prospects of the sugar industry—the industry the Indians, or at least their agitators, make no secret they are out to destroy or gain control over. The sugar companies have, however, thrown down a challenge of a test of strength, and the Indians have come, or are rapidly coming, to a very forcible realization that their prosperity, which all along has been so ample and marked, was only collateral with the prosperity of the sugar industry. The Indians too are seeing the natives taking their places in the sugar fields, and in the mills, and with energies and abilities superior to themselves. There is also afoot among the white settlers a plan to introduce Chinese to Fiji, and then repatriate the Indians. This the Indians do not want, and the Indian Government is hoping it can be avoided. Within the next few months the matter is to be settled definitely. The sugar industry of Fiji will be maintained with or without the Indians.[1]

Fiji is capable of supplying the Empire with all the sugar that is necessary, indeed there is no reason why the colony should not rank first in producing sugar for Imperial needs. Given satisfactory labour conditions, its sugar industry should thrive in a very remarkable manner, and so make the colony one of the richest of our overseas territories.

The Sugar Industry in Natal and Zululand.

By E. WUTHRICH.[2]

Present position.—Cane cultivation is propagated along the coast of Natal and Zululand, stretching over a total length of 240 miles, that is 80 miles south of Durban, and 160 north of that city. The industry of sugar manufacture has developed rapidly since 1905, in which year the production was 29,795 tons. In 1908 it was 50,000 tons, but in 1918 it reached 143,600, an increase of 187 per cent. in 10 years. In 1919 the production was more than double that in 1910. The number of factories is now 25, the largest of which has an output of 15,000 to 16,000 tons of sugar. There are moreover two refineries in Durban.

Though there is no possibility of any expansion south of Durban, large areas are available to the north as far as the boundary of Portuguese East Africa. I have come to the conclusion that if these areas were planted with cane, a production of one million tons of sugar per annum would be a moderate estimate. If this possibility were realized, it would mean that the sugar industry of South Africa, already one of the most important in that country, might grow to be one which would in the future have some influence on the world's markets.

Whereas in former years a good proportion of the total consumption of sugar in the Union was imported from Mozambique and Mauritius, now a much smaller amount is brought into the country. In 1918 it was 13,865 tons; but in 1919 and 1920 very little sugar was imported, due to the high prices of the world's markets, which prices far exceeded the restricted prices established in South Africa. There is a Customs duty of £4 10s. per ton on imported sugar; while the excise duty on sugar made in the country is £1 per ton, refundable if the product is exported.

The sugar industry in South Africa has now advanced to the stage at which it can produce a sufficiency for the entire requirements of the country. Any possible future surplus would have to be exported; but whether this sugar can be made at such a cost as to compete on the world's market remains to be seen.

It is at any rate certain that the possibility of South African sugars finding their way on the world's market would be greatly increased by the introduction of improved methods of cane cultivation and of processes of sugar manufacture more suitable to the juices of the Uba cane. There is no doubt that the production of cane per acre, and the sugar extraction from the juice could be considerably increased. The granting of Imperial Preference by the British Government should prove a great advantage for South Africa, and should give her a good chance to compete against beet sugar and foreign cane sugar. It remains for the Natal industry to do its part in the direction indicated.

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[1] A press report from Melbourne this month states that Mr. KNOX, the managing director of the C. S. R. Co., has left for England to interview the Secretary for the Colonies in regard to this question.—[ED., *I.S.J.*]

[2] Of MITCHELL & WUTHRICH, Consulting Sugar Engineers and Technologists, 115, Holland Road, London, W. 14.

Labour.—Regarding labour it may be remarked that its lack is the everlasting difficulty of the farmer in Zululand, where he has to rely upon the kaffirs. These natives should furnish an abundant and cheap source of unskilled labour, but they are incapable of sustained exertion. After working for a few months, and saving some money, they will return home and remain there for a time, it being impossible to induce them to continue their work in the fields or in the mills for any extended period of time. On the other hand, indentured coolies from India are valuable and steady workers; but as they have multiplied exceedingly since their introduction, their residence is considered by many as a menace to the industrial position of the white man of the country. Their immigration has now been stopped by the British Government.

Climatic conditions.—The rainfall of Natal averages 40 in., with a minimum of 26 and a maximum of 71 in.; while the maximum and minimum temperatures are 33 and 116°F. (shade readings). The crushing season in Natal and Zululand should be from June or July to the end of November; but for various reasons it extends from May to the end of January, or even part of February. Minimum and maximum barometric readings gave the following average monthly figures (9 a.m.): 29·982 and 30·330 in.

Supply of cane.—Cane lands in Natal and Zululand are in the permanent possession either of estates or of farmers, which fact should have a favourable influence on cane cultivation, and on the installation of permanent works, such as irrigation. However, this does not seem to be the case in general; since, as a rule, the cultivation of the cane is not carried on well. Generally, little attention is paid to the selection of plant-cane, ratooning is usually too prolonged, and manuring is often insufficient, though there are exceptions to this state of things. That such conditions will very soon have disastrous results does not require to be discussed.

When Zululand was thrown open by the Government for the cultivation of cane, the land was divided into plots of 300 to 800 acres, which were allotted to farmers on very easy terms, the payment of the land (ranging from £2 to £5 per acre) being spread over 21 years. Provided the applicant was in possession of at least £1000, and was of satisfactory character, these farms could be secured by anyone, even by those who had never planted cane before. There being no experimental station or other advisory body to help the farmers with their difficulties, it is no wonder that the state of cane cultivation in this country is by no means what it should be. All the land up to 160 miles north of Durban has now been opened up; but vast areas suitable for cane cultivation still remain closed as far as the Portuguese boundary. If this territory were thrown open to sugar cultivation, the possibility of a great development of the industry would arise.

The price of the cane is based on the selling price of refined sugar. If, for example, the price of refined in Durban is £18 per ton, then the price of the cane is 12s. 3d. per ton, and rises or falls in direct proportion. Therefore, the cane is entirely sold on weight, and not on its sugar content, or on a combination of weight and sugar content.

Cane cultivation.—As a rule, the whole stick is planted in this country. Two sticks of cane are thrown side by side into the furrow, and the cane cut up into short pieces with a knife; while others cut the cane before it is placed in the furrows. It is then covered up to a depth of about 4 in. by hoeing. Weeds between the plants are removed by hand, and those between the furrows by a pony-plough and scarifier. If all the operations in cane cultivation were properly carried out generally, South Africa would see a great difference in its sugar production. Some farmers do so, but as a rule the preparation of the soil is not what it should be, and the weeds are very often allowed to have their way. Lack of labour may be an important reason for this neglect, though there are other reasons as well.

Manuring.—In Natal, phosphoric acid, potash and lime are often present in the soil in very small amount, so that on manuring with these substances there is a good response, especially when superphosphate and potash are applied, these fertilizers having a great influence on the yield. Although as a rule there are farmers applying manures, who, moreover, experiment on the subject, it may be said that as a rule no proper system prevails, and that many farmers do not manure at all. That this state of things must have disastrous results in the future unless soon rectified seems certain.

Cane cutting and transport.—In Zululand the cane is burnt before it is cut, the trash of the Uba cane being difficult to remove; but in Natal, where more labour is available, this method is not followed. It is transported by ox wagons to the main tramway line of the factory, or to the South African Railway line. No average figures are obtainable for the cost of cutting the cane, but probably 2s. per ton is very near it. The waste of cane on the cutting fields in Zululand is enormous, and if it were saved it would mean a great deal of sugar added to the annual production of the country.

Ratoons.—Ratooning is repeated sometimes as often as seven times, and even more, the ground between the furrows being again ploughed, and the weeds removed as before by pony plough and scarifier.

Time for maturing.—Uba cane in Natal takes from 16 to 24 months to mature for both plant and ratoons. In some parts of Zululand, however, the time is less, plant cane in the "flats" there maturing in 14 to 18 months, and ratoon cane in 12 to 16.

Varieties.—Practically the only variety planted in South Africa is the Uba, the origin of which cane is almost certainly Poona, India. It is a strong, drought-resisting, deep-rooting cane. Green Natal and other varieties which were previously planted are no longer cultivated, either because of liability to disease, or insufficient yield. That such an important industry should rely on only one cane variety is difficult to understand, and no doubt will be seriously regretted, sooner or later. Already in some districts the cane is attacked by certain diseases.

Selection.—Generally in Natal insufficient care is devoted to the plant cane. Some people even maintain that cane which is not good enough to be sent to the mill may be used for plant cane, and the consequences of such ideas are now showing themselves. In a certain district, where in 1917 I was struck by its healthy and vigorous appearance, the Yellow Stripe disease is raging to an extent that probably is not exceeded anywhere else in the world. In another part I found the Red Smut and Vascular diseases, while a great part of the cane growing there was in a very weak condition.

In Natal almost more than anywhere else great care should be paid to the selection of the plant cane, and also to the breeding of other varieties. No irrigation exists, the cane depending entirely upon the rainfall, which is too small really for this plant. Consequently, most of the varieties grown in other countries are unsuitable for cultivation in this country, which requires a variety capable of resisting droughts. If the Uba should be eradicated by a disease (that is degenerated to such an extent as to make cultivation no longer profitable), then it would be a very difficult matter to replace it by another variety suited to the particular climatic conditions of the country. In fact, the visitation of such a disease might mean the ruin of the industry.

Yields of cane and sugar.—That the crop of a plant so influenced by water will vary greatly in a country where it depends entirely upon the rainfall is evident. In addition, of course, the yield will vary according to the nature of the soil. It is impossible to give average figures; but I do not think I am far out by giving the minimum and maximum values for Natal as 10 and 40 tons per acre. On the "flats" near the rivers in Zululand, yields as high as 50 tons have been obtained, and there is no doubt that by proper cultivation (by which term selection of the cane is also implied) an average of at least 40 tons per acre could be obtained on these "flats." It is difficult to state the figures that might be reached under irrigation, but doubtless the result would be surprizing. Seeing that no average figures for the yield of cane are available, average figures cannot be given for the yield of sugar per acre; but probably 0·9 and 4·0 tons per acre as the minimum and maximum values will not be far short of the truth, though the average must be a rather low figure. It may be added that the diminished yield of cane and sugar per acre in South Africa resulting from bad cultivation and from waste on the cutting fields is certainly very considerable.

Sugar content of the cane.—Here, again, no average figures are available, though it may be stated to vary from about 12 per cent. for flat cane to 14 per cent. for hill cane. One must not forget, however, that a great deal of the cane is crushed when it is unripe, so that if grinding took place at the right time these figures for the sugar content would be higher. Factories having 12 per cent. of sucrose in their cane pay the same price for it as those having 14 per cent., though their juices are less pure. Their production in manufacture must therefore be comparatively low, and their hope to make a good profit when ordinary prices prevail lies in the adoption of the most modern and suitable processes which can be applied to Uba cane juices.

Sugar loss in manufacture.—The total sugar losses in the factories of Natal must be much higher than in any other country of the world. In the largest and best operated factories, they vary from 3·5 to 4·5 of sugar per 100 of cane, the figure of 3·5 being obtained by two factories only. In the mill-house the losses vary from 1·3 to 2·0 per cent., and in the boiling-house from 2·0 to 3·0 per cent. These figures relate to six of the largest factories from 1915 to 1918 inclusive, and do not include the smallest factories, in which, judging by their installations, the losses must be enormous. Such abnormal losses are partly due to the nature of the Uba cane and the Uba juice, and for the rest to the inadequate equipment of the factories, which generally is too small to deal with the cane available for crushing. This insufficient capacity means not only overloading, but also the crushing of cane which is unripe, so that the sugar lost under such conditions must be very great.

The fibre content of the Uba cane varies from 14 to 16·5 per cent., and this, as well as the hard nature of the cane, naturally causes a high loss of sugar in the bagasse. It is certain that to obtain a reasonable extraction in milling an installation consisting of at least a crusher and five mills would be necessary.

Juice clarification.—Uba juice is difficult to deal with, even in well-equipped factories, on account of the high amount of gummy matters. Ordinary defecation methods are not suitable; and I am convinced that in order to extract the utmost sugar from the juice of the Uba cane the only method is carbonatation, whether cargo (raw) or white sugar is being manufactured.

In 1918 the carbonatation process was introduced by me into the Mount Edgecombe factory (12 miles from Durban) belonging to the Natal Estates, Ltd.[1] Great credit is due to the Managing Director and Directors of this Estate, who decided to adopt the process in the face of all the difficulties and risks. No doubt they have rendered the country a great service by their splendid enterprise. This process had never been attempted in Natal before, and it was realized that the high content of gum in the juice would involve difficulties. This certainly proved to be so, but the writer has been successful in evolving a modification of the carbonatation process which renders the most difficult juices quite tractable. It is not necessary to apply this modification to all Uba cane juices, but its application secures the success of the clarification operation at any time.

Actually the advantages which have been proved since the introduction of this modification of the carbonatation process in 1919 are as follows:—

(1) A beautiful white sugar is produced. The lower product sugars are mixed with the first product, giving a 100 per cent. white sugar, far superior to the best first product of the finest white sugar produced by defecation in the country. This carbonatation white sugar fetches a much higher price than the defecation white sugar, which difference in price varies with the market, but may be taken at about £2 per ton minimum.

(2) A greater recovery of sugar from the juice, amounting to 7 per cent. In the case of a factory producing say 16,000 tons of sugar, this means roughly 1100 tons extra of first-class white sugar.

(3) An uninterrupted running of the factory, trouble in the filter-press and other departments, which so frequently occurs when treating Uba cane juice by the defecation process, being eliminated. Consequently, apart from the losses of sugar being decreased, the running season is shortened, say by about 10 per cent.

(4) An increase in the capacity of the various stations of the factory, also tending towards a shorter season. Not only does the juice filter more readily, but the time of boiling and curing is also considerably decreased.

It may also be stated that the total increase in the purity[2] from raw sugar to clear juice is about 4° with this modification of carbonatation, whereas by defecation, as applied in the factories in South Africa, it does not exceed 1°, while sometimes the purity even decreases.

However, besides the increase in the purity, the greater yield of sugar is due to other causes, viz.:—

(*a*) Better work at the filter-presses, where the losses at the filter-press station are reduced almost to nothing.

(*b*) Uninterrupted running of the factory, stoppages always causing sugar losses.

(*c*) Better exhaustion of the final molasses, which exhaustion, owing to the removal of gummy matters, can be carried further than ordinarily.

There seems no doubt that the carbonatation process is the future method of clarification in South Africa for the manufacture of cargo (raw) as well as white sugars[3] until other varieties of cane are introduced and a good irrigation system is established.

By-product utilization.—On some estates and farms the defecation scums are placed on the land, and this form of manuring is undoubtedly a very good one for the soil of Natal and Zululand. Some of the final molasses is used for the manufacture of "Natalite" motor fuel[4]; while a quantity of wax has been extracted from the filter-press cake.

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[1] *I.S.J.*, 1920, 287.

[2] In determining the purity, the dry substance was determined by the Brix reading, and the sucrose by double polarization.

[3] There are five factories making cargo sugar, which is sent to two refineries in Durban, all the others manufacturing white sugar.

[4] *I.S.J.*, 1921, 147, 213, 266, 386.

Duties on Refined Sugar in Various Countries.

At a meeting of the Commonwealth Sugar Council at Brisbane last March, a member put in the following approximate list of duties on refined sugar which had been prepared from authentic sources.[1]

DUTIES ON REFINED SUGAR PER LONG TON.

	GENERAL TARIFF.			BRITISH PREFERENTIAL TARIFF.		
	£	s.	d.	£	s.	d.
United Kingdom	25	13	4	21	7	9
Canada	11	3	0	8	7	0
United States	9	19	8		—	
Norway	17	2	11		—	
Sweden	5	14	0		—	
Belgium	10	4	10		—	
Switzerland	3	4	4		—	
Netherlands	22	17	2		—	
Germany	20	6	5		—	
Denmark	5	14	3		—	
South Africa	6	14	5		—	
Portugal	29	9	3		—	
Italy	13	6	8		—	
(Manufacturing and surtax, £80.)						
Peru	3	0	0		—	
Brazil (plus 2 per cent. on off. valuation)	56	2	8		—	
Java, 6 per cent. *ad valorem*		—			—	
Philippines	8	18	8		—	
Cuba	1	19	7		—	
Argentina	12	9	0		—	
Antigua	3	7	0	2	4	8
Bahamas	5	11	3	4	3	6
Australia	6	0	0		—	
British Honduras	7	0	0	4	13	4
Dominica	14	0	0	9	6	8
Grenada	8	8	0	5	12	0
Jamaica	2	4	0		—	
Monserrat	2	6	8		—	
St. Christopher and Nevis	3	7	2	2	4	8
St. Lucia	7	0	0	4	13	4
Trinidad and Tobago	4	9	6	2	4	9
Turks and Caicos Islands	2	4	9		—	
Virgin Islands	2	6	8		—	
Martinique (Octroi, £8 0s. 10d.)	2	8	3		—	
Mexico (approx)	11	0	0		—	
British Indies (approx.)	6	16	0		—	
France	28	14	10		—	
Peru (approx.)	3	0	0		—	
Barbados	9	5	9	4	12	10
Bermuda		free			—	
British Guiana	4	0	0	2	2	0
Guadeloupe (Octroi, £4 0s. 5d.)	8	0	0		—	
French Guiana (Octroi and Consumption Charges, £1 16s.)						

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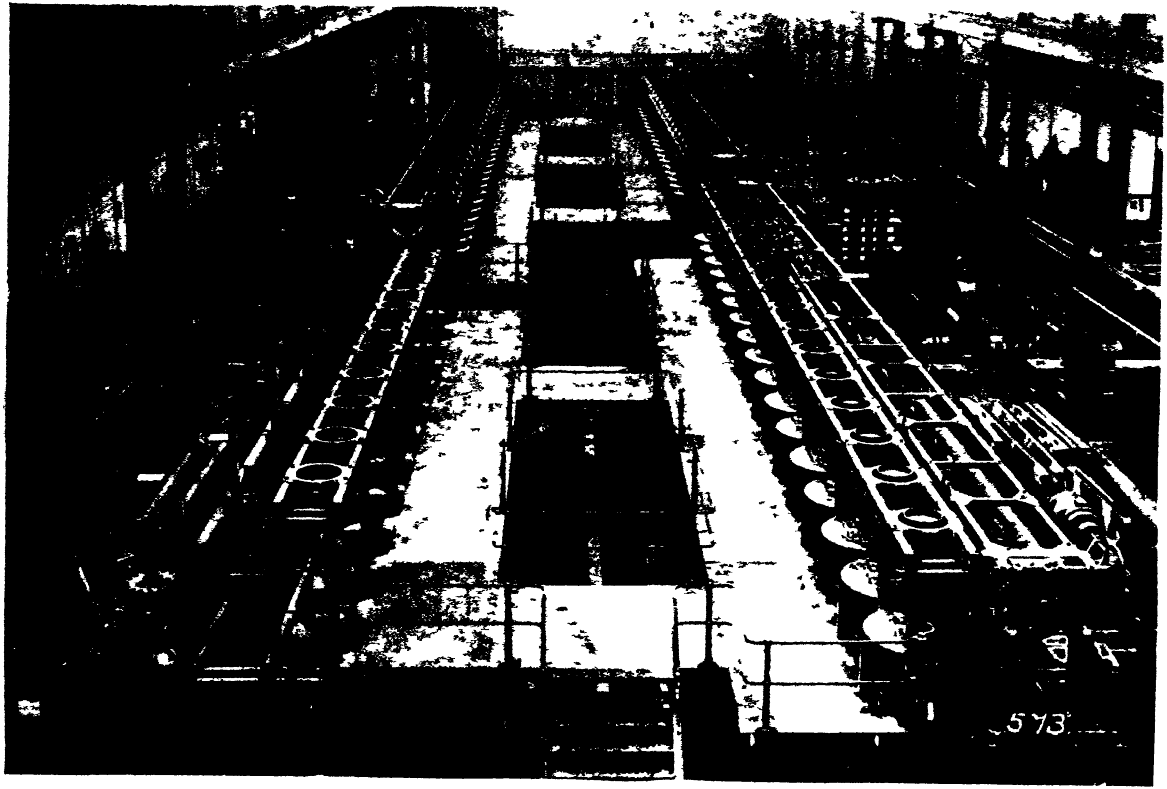
[1] We are indebted to the *Australian Sugar Journal* for the figures.



Centrifugal Installation for Tjomal Sugar Factory Java.

Photographed in the Shops of Messrs. Pott, Cassels & Williamson, Motherwell, Scotland.

A Record Centrifugal Installation.

What we think can claim without dispute to be a record order for centrifugals has just been manufactured by Messrs. Pott, Cassels & Williamson, the well-known centrifugal firm of Motherwell, Scotland, and delivered to the Tjomal Sugar Factory, Pekalongan, Java, one of the largest factory-refineries in the East Indies, which in 1921 ground 2,737,533 piculs (171,291 long tons) of cane.

This large installation consists of no less than 75 electrically-driven units, arranged in two double row batteries of 42 and 33 machines respectively, the baskets being of steel and 36 in. in diam. by 18 in. deep. Each machine, as will be observed, has its own individual overhead electric motor, for three-phase alternating current. These motors, are of very ample capacity and run at about 1200 revs. per min. The centrifugals are driven by the motors through a special form of friction clutch, which also acts as a flexible coupling between the motor and centrifugal. The switches are of special design, and are interlocked with the brakes of the centrifugals. The motors and switches are of such design that they can be switched on to the main direct. Incidentally, there are in all 83 electric motors embodied in this plant.

A special feature of the machines is the method of suspension, which consists of Messrs. Pott, Cassels & Williamson's steel solid spindle with their now well-known combination of ball and sleeve bearings and self-adjusting rubber buffers.

A full outfit of superheated steaming apparatus is provided, with vapour pipes and automatic valves to take the vapours away from the outer collecting cases.

All the framing is of mild steel with a steel chequered plate working platform, 6 ft. 6 in. high, so that with this amount of headroom easy recourse to the accessories underneath the centrifugals is obtained. There are in all four distributing mixers running the whole length of the plant, each driven by its own electric motor through suitable bevel and worm gear. Needless to add, the machines have all the other usual accessories.

Messrs. Pott, Cassels & Williamson are certainly to be congratulated on the securing of so big an order from this Dutch firm, inasmuch as we believe it was obtained in the face of keen competition from other makers; and Continental manufacturers have in the past always figured to a considerable degree in the equipping of Java sugar factories. But Scotch engineering works have had a long reputation for the unrivalled quality of their centrifugal machinery, and this latest instance does not suggest that they are in early danger of losing it.

The second ordinary meeting of Preserve Manufacturers Ltd., which is an amalgamation of several of the leading English confectionery firms, was held in February, and it was announced that a satisfactory year's trading had been held in 1921, and the position of the company was much stronger than a year previously, when they had actually been advised to wind up the business owing to the heavy losses incurred during 1920.

In Germany a movement having as its result the absorption of the refineries by raw sugar factories appears to be taking place. At a recent general meeting of the Halle-sur-Saale Refinery, it was decided after a long discussion to adopt the project put forward by a powerful group of factories in the same part of Germany, this step being urged by Prof. E. O. von Lippmann, the manager of the refinery, as the only means of assuring operation. It appears that the group of factories concerned had come to an arrangement to withdraw their supplies of raws from the Halle refinery; and further would probably turn to the production of white sugars themselves. Many "refineries" in Germany, that at Halle, for example, no longer use boneblack, being now able by carefully elaborated methods of filtration and boiling to make excellent white sugars, which fetch practically the same price on the market as do the finest char-refined grades. It is seen, therefore, that the independent position formerly held by the refineries in Germany is threatened.

Milling Plant Performance Estimations.

By P. H. PARR.

Amongst the very important and ever-recurring questions which have to be dealt with by cane sugar engineers, are those dealing with the grinding capacity of the various sizes and combinations of mills, the horse power required to drive them, the extraction obtained, and other connected factors. The figures are perhaps now roughly standardized, but only very roughly: those given in catalogues vary considerably, and so do the statements of different engineers. Admitted that conditions vary enormously, so that in one factory a milling train may mill perhaps fifty per cent. more than a similar plant in another factory in a different part of the world, still it seems that a fair amount of data is now available, and that some attempt should be made to collate it, so as to offer a set of figures which may be expected to represent fairly the general average practice. Most sugar engineers have tables of their own for mill work, but usually they are far from complete, whilst the differences between them are considerable.

This article offers a few formulæ and tables referring to milling work, which the author believes to represent regular average practice quite fairly, whilst the tables cover all standard mill sizes and combinations, and ordinary cane variations. They represent some of the results of a study of various catalogue tables, of figures used by a number of sugar machinery makers in their offices, and of many factory results—published and unpublished: they make no pretence of absolute accuracy, which is naturally impossible with so many variables, and numbers of plants do better work, but they are in close accordance with many regular working results. The tables have the advantage of being worked out systematically and on a uniform basis, so that, in any case, they may be expected to give good comparative results, and the absolute values can readily be modified by engineers who have the necessary information to enable them to do so, whilst in the absence of such special information, the formulæ and table indicate results which ought regularly to be attained by ordinary milling plants in good condition and under proper supervision.

The subject falls naturally into three sections: first, the tonnage capacity of the milling plants; second, the horse power required to drive them; and third, the extraction results.

In this article, where tons are mentioned, they are to be understood as being long tons of 2240 lbs.; gallons are English, or the volume of 10 lbs. of water; and horse-powers, unless specially noted as being indicated, are to be understood as effective, or brake horse-powers. The horse-powers for the milling trains include the friction of the compound gearings, but not the engine friction, so that the powers given are those for the brake horse-powers of the engines or motors.

CAPACITY OF CANE MILLS.

Various formulæ have been put forward for the tonnage of cane or fibre milled by the various mill sizes and combinations, but the D^2L/C holds its own for a single mill, and appears to agree most closely with average practice, throughout a wide range. Considering the number of mills in a train, the capacity appears to increase about as the square root of the number of rolls, or the number of "squeezes": the author prefers the former, as it is easier to bring to mind the number of rolls than the number of squeezes, and also, a set of revolving cane knives may be called one roll, when their effect comes very well into line with that of the milling plant proper. The only difference between the two assumptions is that the former gives rather more credit to a crusher than does the latter.

Divers values for the dividing constant C are used by different firms and by different engineers, but a fair average, and in close accordance with most ordinary working results, leads to the following formula:—

$$T = \frac{D^2 L \sqrt{N}}{300} \qquad \text{(1)}$$

where T is the number of tons of 12 per cent. fibre cane milled per day of 22 hours crushing, D and L are the diameter and the length of the mill rolls, in inches, and N is the number of rolls in the complete milling train. A shredder may be considered as equal to two rolls, the same as a crusher (no doubt the makers will claim the equivalent of three rolls: they appear to take the power of 2¾ or 3 rolls, and the effect is quite likely in close proportion to the power absorbed), and a set of revolving cane knives about equal to one roll. The number of tons milled per hour is of course:—

$$\frac{D^2 L \sqrt{N}}{6600} \qquad \text{(1a)}$$

and for a single 3-roller mill this corresponds to:—

$$\frac{D^2 L}{3810} \qquad \text{(1b)}$$

tons of 12 per cent. fibre cane per hour. For really heavy work, and with everything in first class condition, 20 and even 25 per cent. more can be milled, but the above corresponds to fair average practice.

Table I.—3-ROLLER MILL.

12 per cent. Fibre in Cane.

MILL.	TON/HR.	H.P.
12·18	0·68	4·5
14·21	1·08	7·1
16·24	1·61	10·6
18·30	2·55	16·7
20·30	3·16	20·7
20·36	3·78	24·8
22·36	4·58	30·0
22·42	5·34	35·0
24·42	6·35	41·7
24·48	7·26	47·7
26·48	8·53	56·0
MILL.	TONS/HR.	H.P.
26·54	9·59	62·9
28·54	11·1	72·8
28·60	12·3	80·6
30·60	14·2	93·2
30·66	15·6	102·0
32·66	17·7	116·0
32·72	19·4	127·0
34·72	21·8	143·0
34·78	23·7	155·0
36·78	26·7	175·0
36·84	28·6	188·0

In Table I there are given the results of (1*b*) for the tonnage milled per hour by single 3-roller mills working on cane with 12 per cent. fibre, and Table II, gives, in round figures, the daily tonnage (22 hours crushing) for all standard sizes and combinations of mills and crushers.

Taking the tonnage capacity of a single 3-roller mill as unity, the relative capacities of trains with a greater number of rolls, according to the $\sqrt{N}$ rule, are:

N	3	4	5	6	7	8	9	10	11	12
r.c.	1·00	1·15	1·29	1·41	1·53	1·63	1·73	1·82	1·92	2·00

N	13	14	15	16	17	18	19	20	21	22
r.c.	2·08	2·16	2·24	2·31	2·38	2·45	2·52	2·58	2·64	2·71

The next question is as to the effect of fibre variation in the cane on the tonnage milled. It is often stated that a mill will pass so much fibre, instead of so much cane, thus making the cane tonnage inversely proportional to the fibre percentage. So far as the author can judge, this allows too great an effect for the fibre, and a mill, although it will not crush so great a cane tonnage of 14 per cent. fibre cane

Table II.—CAPACITY OF CANE MILLS.

NUMBER OF ROLLS.

Tons of 12 per cent. Fibre Cane per day of 22 hours.

Mill.	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
12·18	15	17	19	21	23	24	—	—	—	—	—	—	—	—	—	—	—	—
14·21	24	27	31	34	36	39	—	—	—	—	—	—	—	—	—	—	—	—
16·24	35	41	46	50	55	60	—	—	—	—	—	—	—	—	—	—	—	—
18·30	55	65	70	80	85	90	—	—	—	—	—	—	—	—	—	—	—	—
20·30	70	80	90	100	105	115	129	125	130	—	—	—	—	—	—	—	—	—
20·36	85	95	105	115	125	135	145	150	160	—	—	—	—	—	—	—	—	—
22·36	100	115	130	140	155	165	175	185	190	—	—	—	—	—	—	—	—	—
22·42	115	135	150	165	180	190	205	215	225	—	—	—	—	—	—	—	—	—
24·42	140	160	180	195	215	230	240	255	265	280	290	300	—	—	—	—	—	—
24·48	160	185	205	225	245	260	275	290	305	320	330	345	—	—	—	—	—	—
26·48	185	215	240	265	285	305	325	340	360	375	390	400	—	—	—	—	—	—
26·54	210	245	275	300	320	345	365	385	400	420	440	460	—	—	—	—	—	—
28·54	245	280	315	345	370	400	420	450	470	490	510	530	550	560	580	—	—	—
28·60	270	315	350	385	410	440	470	500	520	540	560	590	610	630	650	—	—	—
30·60	310	360	400	440	480	510	540	570	600	620	650	670	700	720	740	—	—	—
30·66	340	395	440	480	520	560	590	630	660	690	710	740	770	790	820	—	—	—
32·66	390	450	500	550	600	640	680	710	750	780	810	840	870	900	930	960	980	1000
32·72	420	490	550	600	650	690	740	780	810	850	890	920	950	980	1000	1050	1075	1100
34·72	480	550	620	680	730	780	830	880	920	960	1000	1050	1075	1100	1150	1175	1200	1250
34·78	520	600	670	730	790	850	900	950	990	1050	1075	1125	1150	1200	1250	1275	1300	1350
36·78	580	670	750	820	890	950	1000	1050	1125	1175	1200	1250	1300	1350	1400	1425	1475	1500
36·84	630	720	810	890	960	1025	1100	1150	1200	1250	1300	1350	1400	1450	1500	1550	1575	1625

as it will of 12 per cent. fibre cane, will crush a greater fibre tonnage. Apparently, it may be taken that the effect of the fibre is measured by about half of the difference between 12 per cent. and the actual percentage, which leads us to a fibre factor:

$$f = \frac{24}{12 + F} \quad \ldots \qquad (2)$$

where F is the percentage of fibre in the cane, and f is a factor by which the above tonnage results must be multiplied when F is different from 12 per cent. This gives:

F	8	9	10	11	12	13	14	15	16
f	1·20	1·14	1·09	1·04	1·00	0·96	0·92	0·89	0·86

If we consider the nine Philippine Centrals for which the mill particulars are given on p. 688 of this *Journal* for December, 1921, and add together the corresponding daily tonnages from Table II, the total will be found to be 8960 tons per 22 hours crushing, or 407·27 long tons per hour; the average fibre in the cane runs out at 11·45 per cent., so that $407{\cdot}27 \times 24/(12 + 11{\cdot}45) = 416{\cdot}82$ tons per hour is the rate given by the formula, for the nine trains. The sum of the actual results, as given in this *Journal*, is 424·73 metric tons per hour, which is equal to 417·20 long tons, being less than one ton per hour different from the estimation, in over 400 tons. The individual results, of course, vary much more, but the figures furnish one test of the accuracy of the general average results given by the formula. The next question is that of the

POWER REQUIRED FOR CANE MILLS.

It appears to be reasonable to take the power required for milling as directly proportional to the tonnage of fibre, and as increasing with the number of mills. Sometimes it is suggested that the horse-power per ton fibre per hour *per mill* is constant, but such an assumption gives results much too high when long trains are compared with short ones—it would mean that a mill when working as the first in a 12-roll set, would require double of the power taken when working single. It appears to be far more in accordance with practice to assume that the power required by any mill is not affected by adding mills after it; more cane will be passed through, but not crushed quite so dry, the power needed remaining practically the same.

A study of available data shows that the horse-power hours per ton of cane of given fibre content, do not increase quite so rapidly as the square root of the number of rolls, and an index of 0·45 appears to be most suitable. Good average results will be found to be given by the formula:—

$$\text{H.P.} = \tfrac{1}{3}\, F\, N^{0{\cdot}45} \quad \ldots \qquad (3)$$

where H.P. is the total horse-power required by the train, per ton of cane milled per hour, F is the percentage of fibre in the cane, and N is the total number of rolls in the train, cane knives being counted as one roll, as mentioned above. The power required for shredders appears to lie between that for two and for three rolls, being rather nearer to the latter, and, for the present, it appears advisable to allow the equivalent of three rolls for power estimations for shredders. Values of the horse-power required by single 3-roller mills working on 12 per cent. fibre cane, as calculated by formula (3), are given in Table I.

In Table III, are given the values of $N^{0{\cdot}45}$, and of the corresponding horsepowers per ton of 12 per cent. fibre cane. The power figures for one and two rolls are merely added as the formula results, and are of no value—they do not indicate the power per ton when working in a train, but only that which would be taken when working alone, if that were practicable. The column headed RP gives the relative total power for various trains, taking that for a single 3-roll mill as unity.

Since the capacity is taken to vary as $\sqrt{N}$, or as $N^{0·5}$, and the horse-power per ton to vary as $N^{0·45}$, the total power required by the train will vary as $N^{0·95}$, so that the column RP really gives the values of $(N/3)^{0·95}$.

For engine or motor rating, the author recommends adding 50 per cent. to the tabular power for the last (or single) unit driven by such engine or motor, and a few examples are necessary in order to show how the figures of the tables are intended to be used. First, for a single 3-roll 32 in. × 66 in. mill, Table I gives 116 h.p. as required, and adding 50 per cent. to this gives 175 h.p. as a suitable rating for engine or motor. For a similar 5-roll set, Table III gives 0·67 as the relative power factor for the first two rolls of the crusher, and 1·62 for the complete set, being 1·62 — 0·67 = 0·95 for the mill itself: then 116 × 0·67 = 78 is the horse-power required by the crusher, and 116 × 0·95 = 110 that required by the mill, a total of 188 h.p. Adding 50 per cent. to the power required by the last unit—the mill—or 55 h.p., gives 243, or say 250 h.p. as a suitable rating for engine or motor. For an 11-roll set, the total power requirements will be 116 × 3·43 = 398 h.p., while that for the last mill will be the difference between the power for 11-rolls and for 8-rolls, or 116 × (3·43 — 2·54) = 103 h.p., and adding 50 per cent. of this, or 52 h.p. to the 398, gives 450 h.p., as a fair rating for the motor for the 11-roll set.

Table III.

12 per cent. Fibre in Cane.

N	$N^{0·45}$	H.P./TON.	RP.
1	1·000	4·00	0·34
2	1·366	5·46	0·67
3	1·639	6·56	1·00
4	1·866	7·46	1·31
5	2·063	8·25	1·62
6	2·240	8·96	1·93
7	2·400	9·60	2·24
8	2·549	10·20	2·54
9	2·688	10·75	2·84
10	2·818	11·27	3·14
11	2·942	11·77	3·43
12	3·059	12·24	3·73
13	3·172	12·69	4·03
14	3·279	13·12	4·32
15	3·383	13·53	4·61
16	3·482	13·93	4·90
17	3·579	14·32	5·20
18	3·672	14·69	5·48
19	3·762	15·05	5·77
20	3·850	15·40	6·06
21	3·936	15·74	6·35
22	4·019	16·08	6·64

Cane knives fall quite well into line, counted as 1-roller: the tabular value for the relative power factor is 0·34, and for the 32 in. × 66 in. mill we have 116 × 0·34 = 40 h.p. required for a set of knives, plus 50 per cent. giving 60 h.p. for the motor rating, which is quite reasonable. For a 36 in. × 84 in. train, the table gives 65 h.p. as the power required for knives, with 100 h.p. as the motor rating, which is about right.

For a shredder for the 32 in. × 66 in. set, if it is taken as requiring the same as a single mill, we have 175 h.p. as the motor rating, which is probably not far wrong, though a 200 h.p. motor would very likely be installed.

Lastly, consider a 22-roller 34 in. × 78 in. train, consisting of two crushers driven by one motor, and two sets of three mills each, with one motor to each set. We may tabulate thus:—

	N	RP	Diff.	H.P.	
1st Crusher	2	0·67	0·67	104	= 252, say 250
2nd ,,	4	1·31	0·64	99 + 49	
1st Mill	7	2·24	0·93	144	= 490, say 500
2nd ,,	10	3·14	0·90	139	
3rd ,,	13	4·03	0·89	138 + 69	
4th ,,	16	4·90	0·87	135	= 472, say 500
5th ,,	19	5·77	0·87	135	
6th ,,	22	6·64	0·87	135 + 67	
Total horse-power				1029	1250

The first column N gives the number of rolls included to the end of each unit; the second column RP is the corresponding relative power factor from Table III; the third column is the difference between the successive values in the second column, being thus the relative power factors for the separate units; the next column gives the horse-power required by each unit, being the figures of the third column, multiplied by 155 (the h.p. for a single 3-roll 34 in. × 78 in. mill from Table I); then adding 50 per cent. to the power for the last unit of each group gives the final power ratings for the motors. If a final heavy squeeze is desired, to give bagasse of 50 per cent. fibre or more, 75 per cent. may be added to the power for the last mill of the train, instead of 50 per cent. If each mill of the train had its own motor, the powers, allowing the 75 per cent. for the last mill, and 50 per cent. for the others, would be rated at 216, 208, 208, 202, 202, and 238, so that 200 h.p. motors would be suitable for the first five mills (a 225 h.p. motor would be better for No. 1 mill), and 250 h.p. for the last. The above figures show 1030 h.p. as required, and 1250 h.p. as the total motor rating. The tonnage milled per hour will be 23·7 × 2·71 = 64, the actual horse-power being 16·1 per ton, as shown in Table III, and the rating 19·5 per ton.

For 10 per cent. fibre cane, the tonnage will be increased in the ratio 24/(12 + 10) = 12/11, to 70 tons per hour, and the horse-power per ton will be reduced in the ratio 10/12, so that the total power requirements of the train will be $1030 \times \frac{12}{11} \times \frac{10}{12} = 940$ h.p., with a rating of 1150 h.p., being 13·4 and 16·4 h.p. per ton respectively. Similarly, for 14 per cent. fibre, the tonnage will be reduced to 59 per hour, the actual horse-power increased to 1110, and the rated to 1350, being 18·8 and 22·9 h.p. per ton respectively.

Table IV gives the calculated horse-powers required for the various mill sizes and combinations, when milling cane of 12 per cent. fibre, and working at the capacities of Table II. They are given in round numbers, so that there may be slight irregularities, to the amount of, say, 10 h.p., in the powers found for the individual units by taking differences, but this will not cause any difficulty. Regular and consistent results will always be obtained by the use of the figures of Tables I and III, as illustrated by the examples given above.

The tabular horse-power for 12 per cent. fibre cane being taken as unity, the above leads to the horse-power ratio for trains milling cane with other fibre percentages F being given by 2F/(12 + F), the results of which are :—

F.	8	9	10	11	12	13	14	15	16
H.P.	0·80	0·86	0·91	0·96	1·00	1·04	1·08	1·11	1·14

and the tabular horse-power from Table IV must be multiplied by the factors given when the fibre in the cane is different from 12 per cent.

Under favourable conditions, 10–15 per cent. less power than that tabulated will do the work, and with soft fibre canes (not synonymous with low fibre) 15–20 per cent. less may be sufficient. Very hard fibre canes may require a little more, but the allowance already included for rating purposes is sufficient for most cases.

Cane engines should give the rated horse-power (effective or brake), at a piston speed of 500 ft. per min., under the following conditions :—

Boiler pressure, lbs. per sq. in.	80	100	120
Pressure at engine stop valve	70	90	110
Pressure in exhaust main	3	6	10
Cut-off, per cent.	60	55	50
M.E.P. for calculating I.H.P.	35·0	42·5	48·0
M.E.P. ,, ,, B.H.P.	29·0	36·5	41·5
Lbs. steam per I.H.P.-hour	42·5	39·5	37·5
Lbs. ,, ,, B.H.P.-hour	51·0	46·0	43·0

Table IV.—Horse-Power for Cane Mills.

12 per cent. Fibre in Cane.

Number of Rolls.

Mill.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
12·18	2	3	4	6	7	9	10	11	—	—	—	—	—	—	—	—	—	—	—	—
14·21	2	5	7	9	12	14	16	18	—	—	—	—	—	—	—	—	—	—	—	—
16·24	4	7	11	14	17	20	25	30	—	—	—	—	—	—	—	—	—	—	—	—
18·30	6	12	17	20	25	30	35	40	—	—	—	—	—	—	—	—	—	—	—	—
20·30	7	14	20	25	35	40	45	55	60	65	70	—	—	—	—	—	—	—	—	—
20·36	9	17	25	30	40	45	55	65	70	75	85	—	—	—	—	—	—	—	—	—
22·36	11	20	30	40	50	55	70	75	85	95	100	—	—	—	—	—	—	—	—	—
22·42	12	25	35	45	55	65	80	90	100	110	120	—	—	—	—	—	—	—	—	—
24·42	15	30	40	55	65	80	95	105	115	130	140	155	165	180	—	—	—	—	—	—
24·48	17	35	50	65	75	90	105	120	135	150	165	180	190	210	—	—	—	—	—	—
26·48	20	40	55	75	90	110	125	140	160	175	190	210	220	240	—	—	—	—	—	—
26·54	20	45	65	85	105	120	140	160	180	195	210	230	250	270	—	—	—	—	—	—
28·54	25	50	75	95	120	140	160	185	210	230	250	270	290	320	340	350	380	—	—	—
28·60	30	55	80	105	130	155	180	200	230	260	280	300	320	350	380	400	420	—	—	—
30·60	35	65	95	120	150	180	210	240	260	290	320	350	370	400	430	460	480	—	—	—
30·66	35	70	100	135	165	195	230	260	290	320	350	380	410	440	470	500	525	—	—	—
32 66	40	80	115	155	185	220	260	300	330	360	400	430	470	500	525	575	600	650	675	700
32·72	45	90	125	165	210	240	280	320	360	400	430	470	525	550	575	625	650	700	725	775
34·72	50	100	145	185	230	280	320	360	410	450	490	525	575	625	650	700	750	775	825	875
34·78	55	110	155	200	250	300	350	390	440	490	525	575	625	675	700	750	800	850	900	950
36·78	60	120	175	230	280	330	390	440	490	550	600	650	700	750	800	850	900	950	1000	1050
36·84	65	130	190	250	300	360	420	480	550	600	660	700	750	800	850	925	975	1050	1100	1150

Taking the boiler pressure as 120 lbs. per sq. in., the 250 h.p. engine for the crushers of the above example will require a cylinder $\frac{250 \times 33000}{41{\cdot}5 \times 500} = 400$ sq. in. area, or 22·6 in. diam.; say 22 in. if cutting fine, and 24 in. if being liberal. The 500 h.p. mill engines will require double the cylinder area, or cylinders 32 in. diam. The steam consumption at 1030 h.p. will be $1030 \times 43 = 44{,}500$ lbs. per hour: the total condensation in the engines will probably be about 25 per cent., so that there will be $44{,}500 \times 0{\cdot}75 =$ say 33,000 lbs. of exhaust steam at 10 lbs. per sq. in. pressure left for the evaporators.

Before leaving the question of the power requirements for milling plants, a word may be said on the independent drives for cane carriers. It would appear that the horse-power required for a cane carrier is likely to be directly proportional to the cane tonnage per hour, and also to the length of the carrier, and a reasonable allowance appears to be (length of carrier in ft.) × (tons of cane per hour)/500, to which 5 h.p. may be added for the motor rating. For electric motor drives, especially with continuous current, it is of importance *not to overestimate* the requirements: the only D.C. motors suitable for this heavy-torque duty at low and variable speeds, are the plain series-wound machines, and these race at once unless loaded up to rated torque, so that if too large a motor is installed, very large resistances will have to be fitted in order to keep the speed down to the requirements, and will merely waste power. (The author knows of one case where a 50 h.p. motor was fitted to a cane carrier for 50 tons per hour! The "yarn" ran that the speed of the carrier caused half of the cane to jump the crusher and the first mill, and to feed the second mill directly.)

(To be continued.)

The Gilchrist Bagasse Furnace.

It is unnecessary to emphasize the importance of bagasse furnace construction, for it must be realized by all sugar manufacturers that the faulty design of this portion of the factory plant may be the main contributing factor towards the maintenance of a continuous item of expense, namely, that entailed in the purchase of extra fuel, an item that might be eliminated, or at any rate largely diminished, by the installation of a furnace designed on correct lines.

Attention is therefore directed to the recent invention of a new furnace, which is stated to burn bagasse, wood offal and other low-value fuels having a high moisture content with remarkable efficiency.

DEFECTS OF ORDINARY FLAT-GRATE FURNACES.

In the majority of furnaces burning materials of the character named, and provided with a flat grate, the fuel when fed through a hole in the top does not spread out in a thin layer like coal, but builds itself up in the form of a cone.

Under these conditions, there are three distinct stages of combustion proceeding simultaneously. The upper part of the cone (marked *X* in both the drawings here shown), which consists entirely of the fresh fuel, is cold, and cannot rise above 212°F. until the free moisture it contains has been eliminated, only a drying operation taking place in this zone. In the second zone (marked *Y*), the fuel has previously gone through the drying stage in the top of the cone, and at this stage the heat of the furnace is breaking up the chemical constituents of the fuel, and driving part of them off in the form of hydrocarbons and other volatile matter. The lowest part of the cone (marked *Z*) is really a bed of glowing charcoal, the remains of the fuel from which the volatile matter has been expelled, which charcoal burns as in an ordinary coal stove.

As indicated in the sketches, there is a tendency for the products of each of these zones to remain distinct. The cones are more or less impervious to air, so that the only air which enters the furnace will be around the edges of the cone, together of course with whatever may come in through the cleaning-out doors in the furnace front, or the feed opening in the furnace top. Further, there is a very great tendency for any air which may enter from the furnace near the top to be carried along in strata over the hot gases, affording little chance to mix, simply flowing along in a steady stream, and tending to cool off the furnace. It is, therefore, very desirable to eliminate, or at least to minimize the amount of air entering in such ways, and to introduce all the air necessary for combustion through the grates. Thus, it will be broken up into a multitude of small jets, mixed more thoroughly with the gases from the fuel, and become pre-heated.

The furnace which is shown in Fig. I is diagrammatically the same as that used by the United States Bureau of Mines when making their experiments on combustion, and is similar to many of those used in ordinary practice for the burning of bagasse. When used for bagasse burning, the passage is somewhat crooked, in order to economize space and obtain some mixing effect, though the principle remains the same.

In such a design the velocity of the gases leaving the furnace proper (indicated by brackets marked *A*) will be very rapid. Complete mixture and combustion of these gases will not occur for a considerable time, and if combustion is completed when they reach the boiler heating surface, the most rapid combustion and greatest heat will take place in the vicinity of a location indicated by *B*. However, combustion has been occurring continuously throughout this entire passageway or flue, with the result that no high temperature is obtained.

Very little heat from the burning gases at *B* is reflected into the furnace proper at *A*. Only a little combustion occurs in the furnace at *A*; and, due to the large amount of heat absorbed in the evaporation of moisture from the green fuel and the superheating of this to furnace temperature, the temperature at the point *A* must necessarily be very low. Owing to this low temperature, the processes of drying and distillation proceed very slowly.

THE GILCHRIST FURNACE.

On the other hand, in the Gilchrist (patented) furnace,* shown in Fig. II, an enormous area is provided for the passage of the gases directly in the rear of the fuel pile. The width at this point is materially greater than that at a similar position shown in Fig. I. The gas velocity is much less; but the time will be the same for the gases to reach the boiler (which is 42 ft. away in Fig. I). In the Gilchrist furnace, therefore, complete mixture and combustion of the gases will transpire before leaving the furnace. This means that the hottest part of the furnace will be at a point *B*, which is in close proximity to the fuel cones at the point *A*. Owing to this close proximity, the heat from the burning gases will be reflected back upon the fuel pile, and the process of drying and distillation will be greatly expedited, thereby increasing the amount of fuel which can be burned, and the amount of power which can be developed in each boiler.

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* For details as to maker, see pages xl.-xvi.

The Gilchrist Bagasse Furnace.

A point to be noted is that the burning gases in zone *B* of Fig. II pass upward directly in front of and contiguous to a vertical wall of refractory material, which attains a high state of incandescence, as does also the rear portion of the arch. These incandescent surfaces are of assistance in three ways:—

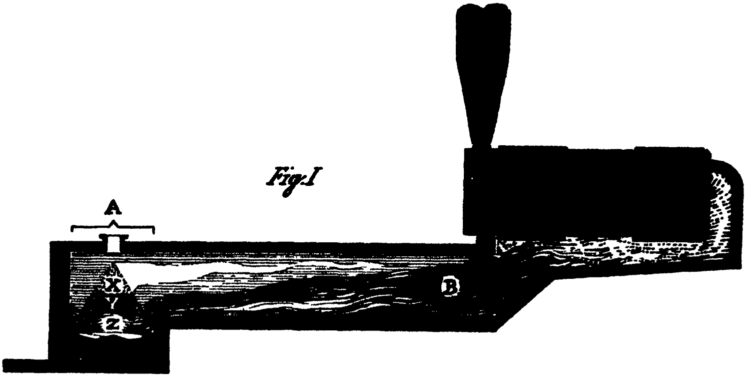
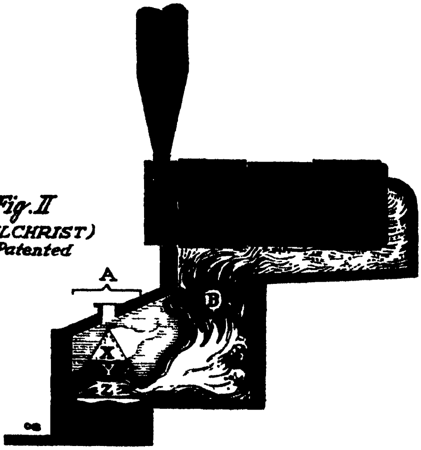


Fig. I

Fig. II
(GILCHRIST)
Patented



(1) *By reflecting heat on the burning gases in zone B, increasing their temperature and facilitating combustion.*

(2) *By reflecting heat through these gases on to the fuel pile, accelerating the process of drying and distillation.*

(3) *Through the increased temperature of the burning volatile matter, they reflect additional heat to the fuel cone.*

Due to the shape of the Gilchrist furnace, as shown in Fig. II, the superficial area is much smaller (for the same cubic contents) than in the case of the furnace shown in Fig. I. Consequently, the heat loss by radiation is greatly reduced, in addition to which the walls are very thoroughly insulated with some form of insulating brick.

Thus, the Gilchrist furnace "bottles up" or confines the heat and intensifies it, because of the following:—

(a) *The shape of the furnace.*

(b) *The radiation of heat from these incandescent refractory surfaces greatly aids in the diffusion, mixing, and combustion of the gases, so that a higher temperature is obtained.*

(c) *Reduces the radiated heat absorbed by the boiler, and deflects it into the furnace.*

On the other hand, in the type of furnace shown in Fig. I, the zone *A* (the distillation chamber) and the zone *B* (the combustion chamber) are separated by a distance of many feet, and are in effect two distinct compartments where two individual chemical reactions occur (namely, distillation and combustion) with but little assistance of one to the other, because of the element of distance.

But in the Gilchrist furnace in Fig. II, the zone *A* and the zone *B* (the distillation and combustion chambers) are integral and combined, so that the chemical actions (distillation and combustion) occur within the presence of each other with the consequent benefits before stated.

In burning both bagasse and wood fuels, finely desiccated particles, which are practically pure carbon, are carried away through the stack by a strong air current. This is evidenced in cane factories and saw mills by the vast amount of embers scattered about the yards, which particles, being pure carbon, are an exceedingly valuable part of the fuel. Their waste is one of the reasons for uneconomical results in furnaces, which are classed as being of the lower temperature type.

In the Gilchrist furnace, the high temperature produced and the refractory walls, which build up and confine these high temperatures, combined with the reduction in velocity of air current at the important zone *B*, bring about a complete combustion of this valuable part of the fuel.

Prof. E. W. KERR, of the Eastern Cuba Sugar Corporation, has presented the following preliminary data from a test on the Gilchrist furnace, the results of which speak well for the unit:—

1.	Duration of test, hours..	10·0
2.	Steam pressure, lbs. gauge	128·7
3.	Temperature of feed water, F.	205·0
4.	,, ,, flue gases, F.	378·5
5.	Moisture in bagasse, per cent.	49·83
6.	Boiler h.p. developed..	1114·0
7.	Equivalent evaporation per lb. of bagasse as fired, lbs...	2·66
8.	Equivalent evaporation per lb. of dry bagasse, lbs.	5·30
9.	Per cent. CO_2	13·62

It was later found that the efficiency of the Gilchrist furnace was 78·3. These figures are very satisfactory.

At the present time there are in the United States 23 refineries with a yearly melting capacity of 7,672,500 short tons;[1] Canada has six of 825,000 tons; and Cuba four of about 300,000 tons. In the case of the United States, its refining capacity is about 1·7 times the consumption capacity (including the 1,000,000 tons of white beet sugar produced). Over half, therefore, of the sugar refined in the United States must be exported at the present time to find a market.

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[1] *La. Planter*, 1922, **68**, No. 5, 68.

Publications Received.

Patents and Chemical Research. Harold E. Potts, M.Sc. (University Press of Liverpool). 1921. Price: 8s. 6d. net.

Many books have been published on Patent Law; but this one has been written especially for the guidance of the chemist, and no one who has had experience of the peculiarities of chemical patenting can dispute that advice on the subject is much required. Its first and second chapters discuss patents as a business policy, and give a clear account of patent procedure. Subsequent sections are devoted to obtaining the maximum protection for an invention; accuracy of experimental data and theory in patent specifications; validity of patents; and the definition of an invention, all of which matters are exposed entirely from the point of view of the chemist. Finally, some particulars are given regarding the patent systems of other countries.

These chapters are full of useful and interesting information, and many good points are expounded. Frequently one hears the complaint that our Patent Office grants patents on "improvements" that appear to be obvious, but it is emphasized that under the British system the function of the Patent Office is to make certain only that the invention claimed is not disclosed in a prior patent, and not to judge whether it possesses subject matter, which is a question for the High Court to decide. On the other hand, as is very well known to patentees, the Patent Office in Germany considers after a very thorough search whether the claims present subject matter. Hence, once a German patent is allowed, its position is perhaps stronger than that of patents taken out in most other countries, though it is remarked that too great severity on the part of the German Patent Office has led to some questionable decisions and some absurd results, patents in some cases having been refused for epoch-making inventions.

One of the best chapters discusses the steps to be taken for obtaining the maximum protection for an invention, in which it is pointed out that a chemical invention must be complete in three senses, viz., in the laboratory, on large-scale operation, and legally, that is, all the possible variations must be considered to provide the strongest possible patent. Infringement may consist of an improvement, an alternative, or an evasion; and the inventor (in collaboration with his patent agent) must explore the field so as to avoid possibilities in this direction and forestall likely objections. British Patent Law penalizes "insufficiency of description" in a specification, which means that if the description proves to be inadequate, or if the working directions are inaccurate, or if there are errors in theory, the patent may be invalid, though now Section 9 of the 1919 Patent Act[1] allows the Court to give relief with certain provisos on the valid claims of a specification, in spite of the invalidity of others.

There is a good discussion of the "claim," which defines the extent of the monopoly awarded to the inventor in exchange for his disclosure, and "marks out the forbidden field." A claim may be bad because it includes something old or something inoperative, or it may be ambiguous or indefinite; while a good one must include all the variations of the real invention. Under the American patent system a multiplicity of claims is allowed, defining the invention from various angles, and covering every possible combination of potential value. The German Office requires claims to be drawn in a stereotyped form; while, on the other hand, in French patents there is no binding claim at all, which naturally leaves the public in uncertainty as to the scope of the patent.

This is in our opinion one of the books necessary to complete the library of the chemical technologist, whose stock of knowledge should include the leading principles of Patent Law. It is of much value alike to the British and American reader.

Potash. By Sydney J. Johnstone. Imperial Institute Monographs on Mineral Resources with Special Reference to the British Empire. (John Murray, London.) 1922. Price: 6s.

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[1] *I.S.J.*, 1921, 709.

International Trade in Sugar.*

. A table giving the sugar imports and exports of the most important countries of the world for a series of years, prepared by the U.S.A. Department of Agriculture for publication in its forthcoming Year Book, is printed below, with the addition by the Bureau of Foreign and Domestic Commerce of the 1921 figures that can be obtained and of certain figures for 1920 that have recently become available. The 1921 figures include the biggest exporting countries; and the total given for exports, therefore, represents a very large percentage of the world export trade in sugar for that year.

This table shows the amount of sugar imported and exported by the countries most concerned in the sugar trade, in 1909-1913 (average), 1918, 1919, and 1920, and in 1921 so far as the figures for that year are obtainable.

[The following kinds and grades have been included under the head of sugar: Brown, white candied, caramel, chancaca (Peru), crystal cube, maple, muscovado, panela. The following have been excluded: "Candy" (meaning confectionery), confectionery, glucose, grape sugar, jaggery, molasses, and syrups.]

COUNTRIES.	AVERAGE, 1909-1913.		1918.		1919.		1920.		1921.	
	IMPORTS.	EXPORTS.	IMPORTS	EXPORTS	IMPORTS.	EXPORTS.	IMPORTS.	EXPORTS.	IMPORTS.	EXPORTS.
PRINCIPAL EXPORTING COUNTRIES	*1000 lbs.*	*1000 lbs.*	*1000 lbs.*	*1000 lbs.*	*1000 lbs.*	*1000 lbs.*	*1000 lbs.*	*1000 lbs.*	*1000 lbs.*	*1000 lbs.*
Austria-Hungary	7,884	1,697,659	—	—	—	—	—	—	—	—
Barbados	*a*466	51,657	—	74,384	—	113,819	—	116,043	—	—
Belgium	15,784	308,952	—	—	110,294	50,222	127,356	158,902	32,802	391,722
Brazil	*a*234	76,568	74	254,926	231	153,063	13	240,612	—	—
British Guiana	*a*12,224	212,393	901	211,896	—	186,254	—	187,658	—	*b*242,524
British South Africa	60,517	1,976	44,159	5,371	5,737	38,016	67	32,614	—	—
Cuba	1,312	4,019,798	290	7,293,915	84	8,995,775	1,758	6,888,802	—	*b*6,264,718
Czecho-Slovakia	—	—	—	—	—	475,091	—	536,600	—	1,033,158
Denmark	43,627	45,073	108	23,263	4,142	20,308	994	34,823	10,441	20,288
Dominican Republic	*c*1,533	184,703	992	264,624	798	357,885	7,779	351,122	—	—
Dutch East Indies	7,124	2,825,111	5,470	3,395,304	6,195	4,115,514	*d*351	*d*3,337,279	—	*e*3,457,845
Fiji	*e*771	157,633	—	141,142	—	144,140	—	163,486	—	—
Guadeloupe	390	75,270	—	58,651	—	39,596	—	52,064	..	—
Martinique	461	85,110	—	45,661	—	—	—	*b*35,632	—	*b*53,362
Mauritius	*a*4	452,510	—	403,961	—	667,610	—	*g*531,901	—	*g*527,488
Netherlands	165,443	400,980	25	51,027	105,134	86,240	92,826	167,827	103,227	355,800
Peru	1,451	293,472	164	436,485	195	599,920	—	—	—	—
Philippine Islands	7,900	358,865	445	602,425	3,261	299,959	5,379	397,579	—	*b*647,000
Réunion	*f*4	83,316	—	83,246	—	110,160	—	88,031	—	—
Russia	7,487	587,028	—	—	—	—	—	—	—	—
Trinidad and Tobago	*a*1,045	87,510	516	78,633	68	84,685	131	107,448	..	104,597

International Trade in Sugar.

Countries.	Average, 1909 1913.		1918.		1919.		1920.		1921.	
Principal Importing Countries.	Imports. 1000 lbs.	Exports. 1000 lbs.	Imports. 1000 lbs.	Exports. 1000 lbs.	Imports. 1000 lbs.	Exports. 1000 lbs.	Imports. 1000 lbs.	Exports. 1000 lbs.	Imports. 1000 lbs.	Exports. 1000 lbs.
Argentina	103,380	144	73,489	21	181,318	3,203	—	180,365	—	—
Australia	152,465	535	*h*117,770	*h*1,956	*i*252,683	*i*340	—	—	—	—
Austria	—	—	—	—	—	—	139,910	17	—	—
British India	1,431,980	53,222	1,190,562	71,221	941,930	52,864	704,285	88,301	—	—
Canada	595,785	1,639	657,926	6,872	1,059,898	246,980	780,877	76,980	769,733	86,764
Chile	169,931	181	195,774	7,249	198,022	1,373	163,005	277	—	—
China	687,243	29,867	1,165,173	26,905	691,717	32,833	514,305	46,621	—	—
Egypt	86,041	16,171	40,704	37,659	27,574	27,973	82,407	30,412	18,116	16,472
Finland	100,153	—	7,548	—	62,468	—	55,203	—	119,631	—
France	372,395	413,795	392,485	136,709	1,331,162	173,619	1,340,174	189,558	725,512	229,510
Germany	6,973	1,746,322	—	—	—	—	203,166	14,162	46,627	—
Hungary	—	—	—	—	—	—	18,231	—	—	—
Italy	18,499	603	81,638	235	175,224	54	25,078	59	—	—
Japan	353,885	120,407	496,720	259,193	606,457	151,841	394,175	202,410	—	—
New Zealand	125,924	*a*26,955	112,974	2,335	131,340	2,643	138,267	1,067	144,612	—
Norway	104,651	—	75,635	—	187,229	—	200,313	—	70,696	—
Persia	218,703	*a*1,114	*j*124,875	*j*3,701	*k*82,557	*k*5,636	—	—	—	—
Portugal	79,262	—	—	—	62,207	—	—	—	—	—
Singapore	163,220	95,878	415,250	345,428	204,728	135,992	91,663	65,951	—	—
Spain	(*l*)	(*l*)	33,497	8,559	65,503	9,505	113,857	1,459	—	—
Switzerland	236,403	—	160,649	—	231,322	1	279,056	1	—	—
United Kingdom	3,707,211	65,207	2,016,755	1,804	3,433,783	2,820	2,477,304	5,035	3,111,194	15,887
United States	4,245,034	79,368	5,170,976	407,296	7,023,620	1,475,408	8,073,760	924,192	5,969,295	933,792
Other countries	954,557	287,612	373,963	190,257	406,141	743,905	424,136	548,768	—	
Total	14,249,356	14,944,604	12,957,507	14,931,784	17,593,022	19,605,247	16,455,826	15,804,078	11,121,886	14,380,927

* From Commerce Reports.

a Four-year average. *b* Willett & Gray's Weekly Statistical Sugar Trade Journal. *c* One year. *d* Java and Madura only. *e* Java only; from the March 1, 1922, issue of *Economisch-Statistische Berichte* (Rotterdam), which gives 3,187,093.000 lbs. as the Java exports for 1920, and 4,011,215 lbs. for 1919. *f* Three-year average. *g* Fiscal years ended July 31, 1920 and 1921. *h* Fiscal year ended June 30, 1919. *i* Fiscal year ended June 30, 1920. *j* Fiscal year ended March 20, 1920. *k* Fiscal year ended March 20th, 1921. *l* Negligible.

In the case of certain countries for which trade returns covering the entire year 1921 are not yet available, it has been possible to get figures for a part of the year. These partial returns of the imports and exports of sugar for 1921 are shown in the following table, with the periods to which they refer:—

	IMPORTS. *1000 lbs.*	EXPORTS. *1000 lbs*
EXPORTING COUNTRIES.		
Brazil (10 months)	—	287,400
British South Africa (11 months)	23,533	135,013
Java and Madura (11 months)	—	3,366,343
IMPORTING COUNTRIES.		
British India (11 months)	1,186,614	15,548
Hungary (9 months)	6,292	—
Italy (9 months)	427,207	682,412
Japan (9 months)	[a]385,484	[b]61,995
Spain (11 months)	103,389	3,944
Switzerland (9 months)	121,401	—

Some Notes on the Cuban Sugar Crop.

(From a Correspondent.)

The present crop is now well advanced, and enables one to survey the situation with regard to production. There are more than 180 factories working, out of a total of about 200; and this must be considered as an extraordinary effort of the country to produce sugar in face of low prices and financial difficulties. While it is a fact that the majority of factories started at a later date this year than in previous ones, it is also a fact that the sucrose in the cane this year stands at a high figure, which allows a high rendement to be obtained from the cane, and consequently many of the factories are a long way ahead of their last year's production to date.

Most of them sent in very conservative estimates, and a plentiful supply of cane, coupled with the rendement referred to, enables many factories to attain to a figure well over their estimates. The 189 factories which sent in estimates expected to make 3,580,000 tons of 2240 lbs., and at the present moment there is every reason to believe this figure is not very much above what the crop will actually prove to be. At the 15th April there were delivered to the seaports about 2,000,000 tons, and with some 220,000 tons at the factories, a total of 2,220,000 tons was made by that date.

The weather continues favourable for harvesting, and every effort is being put forth to get the cane off the ground before the rainy season sets in. The weekly deliveries are holding up, as can be seen from the following table, and the evidence points to a crop of over 3,000,000 tons, but may not exceed 3,250,000 tons.

It is seen that from the beginning of March onward, the weekly production has kept at a high rate, and it is reasonable to expect a high production for a few weeks more.

A few factories have finished their crops, and on the average are ahead of their estimates. By the 10th of May quite a number will have ceased grinding, and after that date the crop will draw to a quick close, with the exception of a few factories that will go on crushing till late in the season.

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[a] Includes 21,029,000 lbs. of "rock candy, cube, loaf, grape, molasses, and the like"

[b] There were also exports of "all other sugar, confectioneries, and sweetmeats," valued at 606,299 yen ($301,937), which are not given separately and for which the quantity is not stated in the monthly returns.

Some Notes on the Cuban Sugar Crop.

APPROXIMATE WEEKLY PRODUCTION.

Long Tons.

		1922.		1921.	
Dec. 10, 1921	.. ..	—	....	950	tons.
17	.. ..	3,700	....	2,800	,,
24	.. ..	6,000	....	2,700	,,
31	.. ..	13,400	....	7,000	,,
Jan. 14, 1922	.. ..	38,900	....	50,000	,,
21	.. ..	56,400	....	74,000	,,
28	.. ..	80,000	....	94,000	,,
Feb. 4	.. ..	93,000	....	124,000	,,
11	.. ..	112,000	....	150,000	,,
18	.. ..	143,000	....	143,000	,,
25	.. ..	155,000	...	179,000	,,
Mar 4	.. ..	165,000	....	150,000	,,
11	.. ..	227,000	....	150,000	,,
18	.. ..	191,000	....	168,000	,,
25	.. ..	172,000	....	140,000	,,
Apr. 1	.. ..	207,000	....	139,000	,,
8	.. ..	207,000	....	182,000	,,
		1,870,400		1,756,450	
Apr. 15	.. ..	180,000	. ..	150,000	
		2,050,400		1,906,450	

Therefore, in spite of low prices of sugar, and a financial stringency, Cuba is again achieving a big crop, and demonstrating her great productivity under adverse conditions.

Havana, April 17th, 1922.

The Thomas and Petree Process.

It is of interest to note that very successful results continue to be reported regarding the Thomas and Petree process,[1] in which the use of filter-presses is entirely eliminated, thus obviating a clumsy and unpleasant operation in the manufacture of sugar.

It was in operation during the past season at the Plantation Uitvlugt, Demerara, and Mr. ROBERT STRANG, the manager of the factory has stated that he considered the process constituted a remarkable improvement in factory methods, and that, in spite of the prevailing depression in the industry, it would pay every factory to install the machinery. He calculated that by its introduction he would save *at least £2 per ton* in cost of manufacture. Since the apparatus had been working, the number of workmen in the factory had been reduced, and the production of sugar was made more quickly. Not only that, but the sugar was of a much better quality than formerly; and he hoped that eventually white sugar would be made.

Many planters have already visited Plantation Uitvlugt, and all declare themselves satisfied that the process constitutes a notable improvement on existing methods.

Further particulars regarding the process are obtainable from the Petree and Dorr Engineers, Inc., 101, Park Avenue, New York.

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[1] *I.S.J.*, 1918, 575; 1919, 33.

Review of Current Technical Literature.[1]

STUDY OF THE METHODS OF DETERMINING CARAMEL IN SUGAR FACTORY PRODUCTS.[1]

M. Kauffman. Archief, 1920, 28, No. 7, 2027-2042.

It is sometimes felt very desirable to have an indication of the amount of caramel which may have been formed during the course of manufacture, especially in working up the final products; and therefore in the hope of being able to recommend a reliable method of ascertaining this information the author has examined the following methods which at one time or another have been recommended for the purpose. *Fradiss' method.*[2]—A weighed quantity of molasses is dried; extracted with methyl alcohol; the liquid treated with amyl alcohol or chloroform; and the precipitate (which is stated to have all the properties of caramel and humic acid) is weighed. Examination of this procedure, however, showed it to give too high results, some of the sugars and mineral matter of the molasses being found in the precipitate weighed. If previously the sample is fermented, better results are no doubt obtained; but even then it is not possible to say whether the precipitate is actually caramel. At any rate, the methyl alcohol does not extract all the colour from the dried molasses; while after the addition of amyl alcohol or chloroform the extract still remains dark brown. *Ehrlich's method.*[3]—Sugar is heated in a flask to 200° C., a definite caramel compound (which has been named "saccharan") being thus formed, which is purified by repeatedly extracting with ethyl or better methyl alcohol. An 0·1 per cent. solution in water of the residue thus purified is used as a standard solution, the intensity of colour of the various sugar products of a factory or refinery being compared with this liquid in the Stammer colorimeter, any increase being assumed to be due to caramelized sugar. Criticism made by the author of this method included the observations that the samples of molasses examined could not be compared with the saccharan solution on account of their haziness, a reading being possible only after very careful filtration, and after rendering both liquids alkaline; and that it was apparent that other substances than caramel, which had a different intensity than saccharan, contributed to the colour. Nevertheless, Ehrlich's method has a certain value in that it is a means of always reproducing a standard solution having a certain degree of colour for the purpose of comparison. *Vermehren's method.*[4]—Two solutions of molasses, each containing 5 grms. per 100 c.c., are prepared, and one is shaken with 1-1·5 grm. of calcined magnesia, which is believed to absorb only the caramel from solution, a comparison of the colour of the two liquids then being made in Hehner tubes, or in similar suitable manner. On doing this, however, the author found with cane molasses that only a small amount of colour was removed; and that the tint of the two liquids was no longer comparable.

DETERMINATION OF REDUCING SUGARS, USING A COLORIMETRIC METHOD FOR ASCERTAINING THE AMOUNT OF CUPROUS OXIDE.

Traugott Bonwetsch.[5] *Centr. Zuckerind., 1922, 30, No. 19, 495-496.*

A solution of the sugar of suitable concentration is boiled with Fehling's solution according to the conditions of the HERZFELD or other well-known reduction method, the cuprous oxide collected on a small and thick filter, and carefully washed with hot distilled water. A clean receiver is now placed under the funnel, and the precipitate on the paper is dissolved by means of a hot solution of ammonia and some dilute sulphuric acid, a solution of the intensely blue compound, cupra-ammonium sulphate, thus being obtained. After washing the filter, the filtrate and washings are cooled and made up to a convenient bulk, say 100 c.c. The intensity of colour of this solution is then compared in a Dubosque-Laurent instrument with that of a standard solution containing a known amount of copper, prepared by dissolving say 0·3 grm. of copper in nitric acid, evaporating down to dryness, with sulphuric acid, adding an excess of ammonia, and making the liquid up to 100 c.c. This method of working is recommended as giving "entirely certain" results, and as being simple and rapid, its *raison d'être* being the substitution of the tedious part of the ordinary gravimetric process (namely the conversion of the cuprous oxide to cupric oxide or to metallic copper) by a simple and rapid means of determining the amount of reduction. A table is given showing *(a)* the depth in mm. of the solution of copper in the colorimeter; *(b)* the amount of copper in mgrms. present in this amount of the solution; and (*c*) the corresponding amount of invert sugar when 10 grms. of the sample are used.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*

[2] *Bull. Assoc. Chim.*, 1899, 280. [3] *I.S.J.*, 1910, 84-85. [4] *Deutsche Zuckerindustrie*, 1911, 679.

[5] Originally published in "Der Zucker in Russland und im Auslande," Dissertation Moscow, 1914.

[6] This is no new method of determining copper, but is the process known as Heine's "blue test." It is often used as a works routine method, which gives sufficiently accurate results in a short time.—Ed., *I.S.J.*

DETERMINATION OF RAFFINOSE IN BEET MOLASSES. *G. Schecker.* *Vereinszeitschrift, 1922, 1-6.*

Doubtless (the author remarks) Herzfeld's procedure and method of calculation for the determination of raffinose is accurate in the case of pure products; but the degree of accuracy that may be obtained when working with impure molasses is uncertain. Preliminary experiments were carried out showing that the addition of sodium chloride to the inverted solution of sucrose affects the reading, e.g., one of — 11·8° being obtained, in place of — 11·3° in the absence of the salt. It was also shown that both extracted boneblack and blood carbon influence the reading when used for the decolorization of the inverted liquid, since when 4 grms. of each were added to 100 c.c. of a ½-normal inverted solution of molasses, the results were — 16·2° and — 16·0° respectively, but — 16·33° when none of the carbon was used. Next the author refers to the influence of the organic salts in neutralizing some of the HCl used for hydrolysis; but this is a source of error that may be obviated (as Prof. HERZFELD points out in a letter to him) by first adding a dilute solution of HCl to the molasses until all the organic acids have been liberated (a point which can be recognized by the colour change when methyl orange or methyl red has been added as indicator), and then adding the usual 5 c.c. of concentrated HCl for hydrolysis. However, being desirous of finding some mode of working which should prove independent of such sources of error as those mentioned above, the author suggests that a solution of the molasses under examination should be treated with barium hydroxide in order to precipitate both sucrose and raffinose, the saccharate being washed with water, decomposed in the cold with CO_2, filtered and washed, a liquid being obtained which consists of an almost pure solution of sucrose and raffinose. After concentration, this liquid would be examined for raffinose by the Herzfeld method. However, from the experiments described it appears that the precipitation of sucrose and raffinose was incomplete, and that the process of treating with barium hydroxide and CO_2 had to be repeated no fewer than five times before a filtrate containing no "plus-sugar" resulted. On adding together the amount of plus-sugar (=raffinose × 1·85) in the five solutions obtained by this tedious procedure, he found 11·2 per 100 of polarization of sugar, whereas the Herzfeld method applied directly to the same molasses gave 12·0 per cent. It is mentioned, however, that in the molasses of the present season a different result was obtained, the difference between this mode of working and the direct Herzfeld method being in this instance rather great.

REAGENT FOR THE DIFFERENTIATION OF SUCROSE FROM OTHER SUGARS. *Ferdinand Kryz.* *Österreichische Chemiker Zeitung, 1921, No. 19, 141.*

According to this writer, he has discovered in an acid solution of nickel ammonium sulphate a reagent which is capable of differentiating sucrose from glucose and lactose. If 1 c.c. of an aqueous saturated solution of nickel ammonium sulphate and the same volume of sucrose solution (containing at least 0·005 grm.) be mixed together, a few drops of concentrated sulphuric or hydrochloric acid added, and the mixture boiled, the green colour soon changes to yellow then to light or dark red, depending upon the amount of sucrose present, this red colour being retained after the liquid has cooled. On the other hand (it is stated) when dextrose or lactose are thus treated, no colour change occurs, nor when protein bodies are present. The reaction in the case of levulose is not mentioned.

ELECTRIFICATION OF THE CROCKETT REFINERY. *Louis F. Leurey.* *Facts about Sugar, 1921, 13, No. 24, 470-476.*

Some further particulars are here given of the electric installation at Crockett Refinery in addition to those already stated,[1] details being described of: the central power plant; main distribution system; group switchboards; control capacity and cost; motors and control; and operating features. The electrification is complete in every particular. No mechanically driven equipment is installed at any point with the exception of a few steam driven auxiliaries in the boiler room. Provision has been made for the full utilization of the exhaust steam from the central generating plant. Low pressure pans have been installed to use exhaust steam exclusively, it having been demonstrated by experiment that all grades of sugar, including confectioners "A" grade, can be boiled in such a pan with better results as to quality than could be secured in the high pressure pan.

\POLARIZERS OF SACCHARIMETERS. *Adam Hilger, Ltd.; Wm. E. Williams; and Chas. F. Smith.* *United Kingdom Patent, 166,842.*[2]

CONVERSION OF BAGASSE INTO A NITROGENOUS MANURE. *K. Adinarayana Rao.* *Journal of the Madras Agricultural Students' Union, 1920, 8, No. 7, 184-189.*

Further particulars regarding these experiments are now available.[3] They are parallel with the tests that have been made at the Rothamsted Experimental Station on the utilization of straw for the production of farmyard manure,[4] and are of much interest especially to agriculturists in countries where an excess of bagasse is available. Mr. RAO suggests that treatment might be carried out in two ways: (1) by inoculating the bagasse with cellulose-decomposing organisms, sterilizing, then inoculating with nitrogen-fixing organisms; or (2) by introducing both types of organisms at the same time for their simultaneous propagation. In his tests the bagasse was inoculated either with *Clostridium* and *Azotobacter*, or else with *Clostridium* and *B. radicicola*, and incubated at 30°C. Results are given showing that the amount of nitrogen in the fermented product after two months presence was 1·2 to 1·4 per cent. (that is, about twice as much as is contained in farmyard manure), and it is believed that possibly more might be fixed after a longer time and under improved conditions. Decomposition appeared more pronounced when a pure culture of cellulose-decomposing organisms had been used, the product darkening in colour and emitting a foul smell. It is intended to continue these experiments, the author realizing their importance to agriculture in India.

EFFICIENCY OF VARIOUS MOTOR FUELS CONTAINING ALCOHOL IN ADMIXTURE WITH PETROL (GASOLINE), BENZOL, AND ETHER. *E. Humboldt.* *La. Planter, 1922, 48, No. 6, 94-95.*

Pure alcohol is not a satisfactory fuel for the ordinary internal combustion motor unless some radical changes are made in the carburetter, for the simple reason that alcohol does not "carburet" cold air owing to its low vapour tension and its high heat of evaporation, which is about four times that of gasoline. Consequently, even when using an excess of air, the air must be preheated nearly to the boiling point of water if a perfect vaporization is desired. Addition of gasoline is not entirely satisfactory, unless it is of very low boiling point (as in the highest grades). Alcohol containing 20-30 per cent. of benzol carburets fairly well at ordinary temperatures and if the air is slightly preheated the carburetter does not cool down too much; but even under these conditions a motor running at high speed will often show a carburetter frosted with ice outside. Increasing the amount of benzol to 45-50 will remedy these defects, but the composition is too expensive. Mixtures of alcohol with 25-40 per cent. of ether carburet readily even in very cold weather, and are fairly satisfactory so long as the air supply is preheated during running to prevent excessive cooling of the carburetter owing to the rapid rate of evaporation. Indeed, in the tropics 20-25 per cent. of ether with a good warm air supply seems to give better results than are obtained from a higher percentage of this addition. But without doubt (it is said) the best mixture for general use is that containing alcohol and benzol (80 to 20 per cent.) with ether (15–20 per cent.) A motor run on this fuel starts easily in the cold, picks up the load well, does not choke up or foul the engine, while the consumption is about identical with that of gasoline under the same conditions. The benzol can be replaced by good gasoline, and some pyridine added as denaturant and for neutralizing acid products of combustion. A similar mixture is being marketed in France, with very satisfactory results, its composition being: alcohol (95 per cent.), 60; ether, 25; benzol (90 per cent.), 14; and pyridine, 1 per cent.

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[1] *I.S.J.*, 1921, 617-618; 1922, 44.

[2] See *I.S.J.*, 1922, 105.

[3] *I.S.J.*, 1922, 73.

[4] *I.S.J.*, 1922, 45.

Mutual Chemical Control Results, and the Calculation of the Sugar Losses of all Factories, on the same Juice Purity Basis. (1) *W. Young. Archief, 1921, 29, 1804-1805.* (2) *F. Leistra. Ibid., 1921, 29, 1806.*

(1) It is pointed out by the writer that in the Mutual Control Sheets compiled by the Java Sugar Experiment Station the figures certainly show the sucrose balances or the losses in bagasse, press-cake, molasses, etc., in the case of individual factories, but that these are not comparative values. If, for example, factory A is working a juice of lower purity than factory B, then its loss of sugar in the molasses will be greater and its yield of product will be less, but although this is so it is desirable to know at a glance whether it is working more or less efficiently than factory B, and this one cannot do with the figures in their present form. He therefore suggests that in the 15-day returns a column should be introduced in which the figures respecting the losses are all calculated on a basis of raw juice of the same purity, say 85°. An example of the method of calculation which might be followed is stated. Given the purity of the raw juice, clarified juice, and molasses as 86·1, 83·5 and 38·1; then the sucrose balance on the basis of a raw juice purity of 81·6° is: sucrose in sugars, 81·9; lost in press-cake, 0·9; lost in molasses, 11·5; and unknown losses, 5·7 per cent. Now calculation to the basis of a purity of 85° is carried out by the following steps. Precipitated non-sugar per cent. non-sugar in the juice

$$= \left\{ \left(\frac{100}{\text{purity raw juice}} - \frac{100}{\text{purity clarified juice}} \right) : \left(\frac{100}{\text{purity raw juice}} - 1 \right) \right\} \times 100$$

$$= \left\{ \left(\frac{100}{81\cdot6} - \frac{100}{83\cdot5} \right) : \left(\frac{100}{81\cdot6} - 1 \right) \right\} \times 100 = 11\cdot24.$$

Purity of clarified price on the 85° basis:

$$= \frac{85}{100 - \frac{(100 - 85) \times 11\cdot24}{100}} \times 100 = \frac{85}{93\cdot314} \times 100 = 86\cdot45.$$

Then the lower loss of sugar in the molasses when the purity of the clarified juice is 86·43 will be:

$$= 100 \left(\frac{100}{83\cdot5} - \frac{100}{86\cdot43} \right) \times \frac{38\cdot1}{61\cdot9} = 2\cdot65.$$

And the loss on the press-cake will be clarified juice purity of 86·43 $= \frac{86\cdot43}{83\cdot50} \times 0\cdot9 = 0\cdot93$. Thus the sucrose balance on the basis of the 85° purity becomes: sucrose in sugars (81·9 + 2·65), 84·55; lost in the press-cake, 0·93; lost in the molasses (11·5 — 2·65), 8·85; and unknown losses, 5·67 per cent.

(2) Mr. Leistra replies to Mr. Young by saying that he considers the calculation to the basis of 85° (or other suitable uniform value) unnecessary, and that the value "standard muscovado, per 100 of available sugar calculated according to P. G." (which now appears in the Mutual Control Sheets) should suffice for all purposes of comparison, since it gives a figure which is independent of the composition of the juice. Besides, Mr. Young's method of calculation depends on the *quantity* of non-sugar, while it is now very well recognized that its *quality* is an important consideration both in the purification of the juice and in the exhaustion of the molasses.

Sugar Manufacture in Louisiana [Milling Control Results, Juice Weighing, Scale Formation in Heaters used in Sulphitation Process, and Continuous Filtration of the entire Juice]. *W. M. Grayson, Albert O. Levert, and F. W. Zerban. La. Planter, 1922, 58, No. 11, 174-175.*

This is the report of the Committee on Manufacturing Progress in Louisiana, the more interesting points of which may be summarized as follows: Without doubt there is more room for improvement in mill work in this State than in any other department of manufacture, and the table here reproduced shows what six of the factories are doing in this direction, the dimensions of the rollers being 34 in. × 84 in.:—

	Pressure on top roll—tons				Rate, tons per hour.	Maceration.	Normal Extraction.	Fibre in Cane.
	C	1st	2nd	3rd				
1.	200	290	486	486	60	12·5	80 3	11·2
2.	118	260	325	452	46	23·5	80·2	12·0
3.	—	285	304	342	50	4 0	78·0	10·3
4.	150	279	279	364	45	6·0	75·0	11·6
5.	150	300	350	400	45	9·5	78·5	11·3
6.	170	250	450	—	38	15·0	78·0	11·0

In a few houses, juice scales have been installed with very satisfactory results from the point of view of chemical control. Careful comparisons of the actual weight and that calculated from the volume show a variance of 2 per cent. above and the same amount below the true figure; and from this it would seem that the calculation of the weight from the volume may be so inaccurate as to render the mill results, e.g., the extraction figure, altogether untrustworthy. Trouble is generally experienced in the sulphitation process on account of the formation of scale in the heaters; but it is said that this can be overcome to some extent by increasing the velocity through the apparatus by coring the tubes. A velocity of 700 ft. per min. will obviate scaling entirely. One of the ideals in sugar manufacture is the entire filtration of the juice continuously. No inventor has hitherto approached this condition; but it is mentioned that the Vachière filter, which was tried out in the State last season, has given very promising results. It is described as a continuous apparatus in which a portion of the cake is removed as soon as it is formed, leaving a coating of say ¼ in. on the cloths to serve as the filtering medium.

Use of Lime containing Magnesia (Dolomitic Lime) for the Carbonatation of Beet Juices. *Karl Andrlik and Wenzel Kohn. Zeitsch. Zuckerind. cechoslov. Republic, 1922, 45 (iii), No. 24, 263-267.*

It has hitherto been generally accepted by technologists that when applying the process of carbonatation for the clarification of juice the lime used should contain little or no magnesia, owing to the fact that this constituent usually passes into solution in the juice in which during subsequent working it gives rise to various irregularities. However, by means of laboratory experiments these authors show that so long as the alkalinity of the first carbonatation is maintained at about 0·1 per cent, no magnesia can pass into the juice. Furthermore, using a lime made from a dolomite containing 35·76 per cent. of CaO, 16·40 of MgO, and 46·81 of CO_2, juices were obtained which after carbonatation were clearer, lighter, and sometimes purer than those obtained under otherwise similar conditions with the use of lime made from limestone containing a minimum amount of magnesia, the procedure being to add 2½ per cent. of the dolomitic lime or ordinary lime in the form of milk at 17°Bé. (1·131 sp. gr.) to the juice heated to 80°C., to saturate with carbon dioxide to an alkalinity of 0·1 per cent., to filter, to heat the filtrate to 80°C., to saturate with carbon dioxide to 0·01 per cent., to heat to boiling point, and lastly to filter. In certain of the experiments the 2½ per cent. of dolomitic lime was added in two portions, first a preliminary amount of 0·4 per cent., the liquid being decanted from the precipitate settling out, then 1·85 per cent, this procedure being compared with that in which all the 2½ per cent. was added at the same time. One might perhaps expect for some reasons that a better result would be obtained with the two additions; but this was certainly not the case, both the purity and colour of the juice to which the 2½ per cent. had been added at once being distinctly better than the other, in all probability owing to the greater volume of the precipitate formed on carbonating. It is hoped that these experiments will be continued in the factory, and carried yet further than the clarification stage, namely, to the study of the behaviour of syrups and molasses.

UTILIZATION OF MOLASSES FOR THE PRODUCTION OF ALCOHOL AND YEAST. *Henry Arnstein.* *La. Planter, 1922, 68, 76–78, 125–126, 191–193, 209–210, 221–225.*

A description is given of the process and plant used for the modern production of alcohol (and incidentally yeast), from molasses, or alternatively grain, or both together, using pure cultures for so doing. Descriptions and illustrations are given of methods of yeast culture, and distillation and rectification plant.

AVERAGE ANALYSES OF PORTO RICAN RAW SUGARS. *W. D. Horne.* *Facts about Sugar, 1922, 14, No. 11, 212.*

In a previous paper the author gave average analyses for 20 years past of Cuban raw sugar[1]; and now he gives similar data in respect of raws from Porto Rico, representing more than 600 cargoes received during 21 years past:—

PERIOD	POLARIZATION.	GLUCOSE.	WATER.	ASH.	ORGANIC MATTER.	FACTOR OF SAFETY.
1901–10	95·625	1·295	1·290	0·485	1·305	0·295
1911–20	95·713	1·407	1·133	0·525	1·222	0·264
1921	95·784	0·401	1·255	0·522	1·038	0·297

Attention is called to the comparatively low ash content, which commends these sugars to the refiner.[2] They appear to have improved decidedly during the period covered by the record, the polarization showing a slight rise, and the organic impurities decreasing, the result being an improved keeping quality and a generally better suitability for refining.

THEORY OF THE HALF SHADOW POLARIMETER. *H. Schulz.* (1) *Physikalische Zeitschrift, 1920, 21, 33–38.* (3) *Verhandlungen der deutschen Physikalischen Gesellschaft, 1920, 21, Nos. 9–10, 227–235.*

REPORT OF THE NEW YORK SUGAR TRADE LABORATORY FOR THE YEAR ENDING DECEMBER 31ST, 1921. *C. A. Browne.* *New York Sugar Trade Laboratory, Inc., 80, South Street, New York.*

In 1921, the number of samples of sugar tested was 15,147, the lowest of any year since 1910, the decrease being due firstly to the smaller receipts of sugar, and, secondly to the increase in the number of bags making up a laboratory sample, being 1709 during this year as compared with 1610 in the previous one. In addition to its regular routine, the laboratory carried on a certain amount of research work during 1921. Complete analyses were made of typical raw cane sugars imported from different countries, the chloride content of these sugars being also investigated with reference to the frequently occurring question of salt water damage. The effects of deterioration upon the composition of the sugars examined by the laboratory was also studied. In connexion with the testing of an importation of refined beet sugar of high polarization, a research upon the optical method for analysing mixtures of sucrose and raffinose was undertaken and the results have been published.[3] An examination by the laboratory of the errors of certain modifications of the Clerget method has also been printed.[4]

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[1] *I.S.J.*, 1921, 351.

[2] In the Cuban analyses, the average ash content was 0·60 per cent.

[3] *I.S.J.*, 1922, 101.

[4] *I.S.J.*, 1921, 166, 276, 516.

DETERMINATION OF REDUCING SUGARS IODOMETRICALLY USING BRUHNS' METHOD.

(1) ***G. Bruhns.*** *Centr. Zuckerind., 1919, 34, 621.* (2) ***P. Beyersdorfer.*** *Vereinszeitschrift, 1920, 35, 259.* (3) ***Ed. Kunz.*** *Centr. Zuckerind., 1922, 30, 802.*

(1) Several papers have been published during recent years on the determination of reducing sugars using an iodometric method for ascertaining the amount of copper remaining unreduced,[1] in which direction a good deal of work has been done by BRUHNS, who now claims to have elaborated a procedure by which the determination of invert sugar can be carried out with greater accuracy and rapidity than by any other, the details being as follows: 10 c.c. of copper solution (69·28 grms. of crystallized copper sulphate per litre) and 10 c.c. of alkaline tartrate solution (346 grms. of Rochelle salts and 1000 grms. of sodium hydroxide per litre) are well mixed with 20 c.c. of the sugar solution (containing not more than 4 grms. of sucrose) in an Erlenmeyer flask having a capacity of about 200 c c. This flask is placed on wire gauze covered with a circle of asbestos 60 mm. (2⅜ in.) diam , and its contents heated to boiling point, ebullition being continued with the smallest possible bunsen flame for exactly 2 min. At the end of this time 50 c.c. of distilled water at room temperature are added, the mouth of the flask closed by means of a small beaker, and the mixture cooled by means of a jet of water, while the flask stands in a shallow tray. A burette having been filled with thiosulphate solution (34·4 grms. of sodium thiosulphate and about 0·1 grm. of sodium hydroxide in 1000 c.c.), 5 c.c. of potassium thiocyanate iodide solution (containing 0·67 grm. of KCNS and 0·1 grm. of KI) are added to the cooled liquid, then 10 c.c. of 6/N HCl (the contents of the flask being well mixed after each addition), immediately after which the thiosulphate solution is run in (well mixing all the time). When the brown colour has faded to grey, starch solution is added, and the titration continued until the liquid is no longer blue or grey after 5 min. When much cuprous oxide is present, the starch solution should be added at the commencement of the titration; and if the mixture has been cooled only to 30°C., or if some cuprous thiocyanate from a previous titration has been added, the separation of the precipitate during titration will be facilitated. In order to establish the "blank," a similar test is carried out, but without heating, and always an allowance must be made for the reduction due to the sucrose, preferably by reference to a table which has been compiled

(2) At the request of BRUHNS, Dr. BEYERSDORFER has examined the method with great care, in comparison with others recognized as reliable. In general, the results obtained were satisfactory. With relatively pure products the new method gave practically the same values as Beyersdorfer's method[2] and the standard Herzfeld gravimetric procedure. In the case of molasses, however, the results were not always so close, though in some cases the agreement was good, the divergencies being attributed to the presence in the molasses of non-sugar reducing substances, which in some way appear to render the results irregular. It is mentioned that the end-point is not easy of recognition, and that it seems to vary somewhat according to the colour of the sample examined and the amount of the reducing sugars present. Generally, however, after some experience the colour-change (usually from bluish-grey to flesh tint) can be judged with a fair degree of certainty.

(3) Dr. KUNZ has also examined the method; and on the whole reports favourably of it. When differences in parallel determinations with Bruhn's method are observed they are more likely to be due to irregularities in the time of heating than to any difficulty in recognizing the end-point in the actual titration of the amount of the copper. It is really quite not far from easy to judge the exact moment at which boiling actually commences, and an error of 10 sec., that is, 8 per cent. of the total duration (2 min.) can readily occur. Careful determinations carried out by Dr. KUNZ lead him to agree with BEYERSDORFER that the table given by BRUHNS for the calculation of the percentage of invert sugar in the presence of varying amounts of sucrose is unreliable so far as the lowest amounts of invert sugars are concerned. This is due mainly to the uncertainty in fixing the time of heating, to which allusion has just been made.

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[1] See SCHOORL, *I.S.J.*, 1916, 334, VAN NOUHUIJS, *I.S J.*, 1920, 411; 1922, 149.

[2] *I.S.J.*, 1920, 107.

Review of Recent Patents.[1]

UNITED KINGDOM.

Purifying Liquids (e.g., Syrups with Decolorizing Carbon). *A. J. H. Haddan* (assignee of *J. N. A. Sauer*, of Amsterdam, Holland). *172,962* (*33,532*); *addition to 163,505*. December 13th, 1921; convention date, December 30th, 1920.

The process and apparatus disclosed in the parent specification[2] are so modified that the passage of the liquid from the mixing-chamber to the separator and the passage of the solid matter separated back to the mixing-chamber take place along separate paths, the separated solid matter being mixed with the liquid to make a pasty fluid which is conveyed back to the mixing-chamber. In the apparatus shown in Fig. 3, the liquid enters the mixing-chamber *1* by the pipe *18* the solid reagent being inserted through an opening *19*, the vanes *15* being operated to impel the contents from the centre towards the ends of the chamber. The liquid with the reagent in suspension passes up the passage *2* to the separator *3* consisting of a series of bag-filters *4* which may be enclosed in a casing *49*, the liquid entering the casing at the top. The solid matter deposited on the filter cloths is detached by reciprocating wire scrapers *8* and falls into a collector *9*, in which revolve agitators *10* to homogenize the pasty fluid which is then withdrawn by a pump *21* through a pipe *22* and discharged into the mixing chamber *1*. An agitator *24* prevents the solid matter which accumulates at the top of the filter-chamber from caking together and the pasty fluid may also be withdrawn from this point by a second pipe leading to the pump *21*. In a modified form, the collector *9* and pump *21* are dispensed with and a cylinder *51*, Fig. 8, fitted within the passage *2* so as to form an annular passage *52* by which the liquid passes from the mixing-chamber to the separator, and a central passage 53 through which the separated solid matter falls back to the mixing-chamber. The passage *53* may be open or may be fitted with a removable cover and bottom which may take the form of plates *54*, *55* pivoted on spindles *56*, *57* which can be turned by racks and pinions or other gearing to open or close either pair of plates. When the upper pair is opened and the lower closed, the solid matter accumulates on the lower pair, and when these are opened, the upper pair having been closed, is thrown down into the mixing-chamber. The cylinder *51* may be dispensed with and plates *54*, *55* extending right across the passage *2* employed having the peripheral parts perforated to work the upward passage of the liquid, the solid matter collecting on the central parts. The wire scrapers *8* are carried by a frame carried by rods

FIG 3

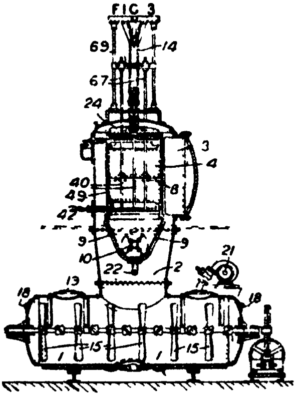
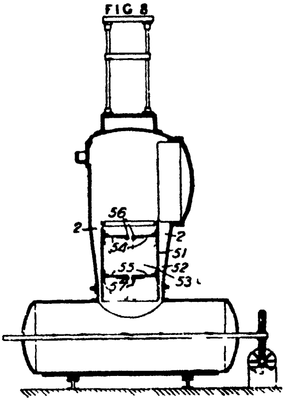


FIG 8



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[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2fr. 00 each).

[2] *I.S.J.*, 1921, 535.

67 attached to a cross-bar *69* which is reciprocated by means of an endless chain *14* or by a screw having reversing gear the clutch of which is operated by a tappet device. Contact between the wires and the filter-cloths is normally prevented by iron strips *40*, but the bags may be inflated with air, gas, or steam injected through inlets *42* to complete the cleaning and the scrapers may or may not be operated simultaneously, the supply of liquid being preferably shut off. Lastly, materials so separated may be removed and the final separation effected by evaporating or draining off the liquid, or by a centrifugal apparatus.

PURIFICATION OF JUICE BY THE ADDITION OF A SOLUBLE ALGINATE. *Soc. Ricard, Allenet & Cie.*, of Deux-Sèvres, France. *173,735* (*24,928*). September 20th, 1921.

Saccharine liquids, such as beet juice, milk serum, and apple juice are purified by adding a soluble alginate[1] and precipitating alginic acid with an acid or calcium alginate with lime. The precipitate carries down the impurities and is separated by filtration and used as a food for animals.

REFRACTOMETERS. *Carl Zeiss*, of Jena, Germany. (1) *172,621* (*31,747*). (2) *172,622* (*31,748*). November 28th, 1921.

(1) The construction of refractometers of the Abbe type is modified to enable such instruments to be fitted to the side of a vessel containing liquid which it is desired to examine. A casing *a* (see Fig. 1) provided with a flange a^1 is fitted with a prism *b* arranged so that the main reflecting surface b^2 is in contact with the liquid through the wall of the container. The prism *b* has four optically effective surfaces, viz., entrance and exit surfaces b^1, b^4 and two reflecting surfaces b^2, b^3, the latter surface deflecting the rays from the surface b^2 through about 90 degrees. The telescope *c*, which moves over a graduated arc *f*, is provided with an objective c^1 and an achromatizing prism *d*. In order to clean the prism face b^2, a rotary arm *k* is pivoted on the axis *h*, and when rotated will remove any deposit on the face b^2. If necessary, the face b^2 may be rinsed by a fluid supplied through the nipple i^1 and through the hollow axis *h* and arm *k*. The arm *k* is swung to one side when measurements are being made.

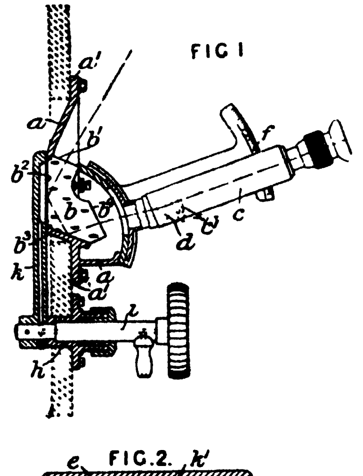
FIG I

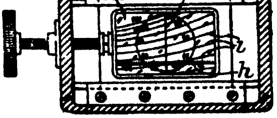
FIG.2.

(2) Refractometers of the Abbe type are provided with means whereby the influence of temperature on the refractive index of solutions is taken into account, so that the percentage content of the solution can be directly read in the eye-piece of the instrument. The eye-piece is fitted for this purpose with a glass disc *e* (see Fig. 2) adjustable in a direction at right-angles to the movement of the boundary line, having engraved on it a temperature scale *h* and a series of percentage curves *i* corresponding to the temperature scale. A second disc is fixed and has a line k^1 perpendicular to the boundary line seen in

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[1] Alginates may be prepared from certain *Algæ* by solution in sodium carbonate and repeated precipitation of the alginic acid (or algin) with hydrochloric acid. Pure alginic acid probably consists of a complex, composed of compounds of the pentosan type and cellulose. Reference may be made to a paper by HOAGLAND in the *J. Agric. Research*, 1915, 4, 39, for further particulars of this substance.—ED., *I.S.J.*

the field of view. In use, the temperature of the solution is determined and the scale *e* set on the line k^1 in accordance with the determination and the point at which the boundary line appears to cross the line k^1 is utilized to read off the percentage content of the solution.

CLARIFYING CENTRIFUGAL. *L. Berard*, and *L. Drin*, of 54 bis, rue Michel-Ange, Paris. *173,745* (*33,557*). December 14th, 1921; convention date, January 4th, 1921; *not yet accepted;* abridged as open to inspection under Section 71 of the Act.

In this specification a centrifugal is described in which provision is made for the filtration of the liquid under treatment, first through pulverent clarifying substance, and then through filter-cloth. Previous to entering the machine, the liquid is passed through a stationary wire cloth strainer and decantation apparatus.

CANE CUTTING APPARATUS. *C. J. D. Symons*, of Johannesburg, Union of South Africa. *173,844* (*28,086*). October 4th, 1920.

An apparatus suitable for cutting cane, sisal, etc., consists of a rotary power-driven cutter disc mounted in a part-circular frame *3* provided with a handle *6*, a pair of forwardly projecting horns *7*, and upper and lower cover-plates *4*, *5*, clearance slots *9* being formed in the sides of the casing. The cutter disc *1* is preferably provided with saw teeth, and is fixed on a spindle *10*, which is mounted on ball bearings *11* and on a footstep bearing. The spindle is driven by bevel-gearing from a shaft *15* passing through the handle and connected by a flexible shaft to a motor. In a modification, the casing is mounted on wheels and is provided with a T-shaped handle for directing it, and the cutter is driven by gearing from a turbine mounted on the casing and actuated by compressed air or steam supplied by a hose.

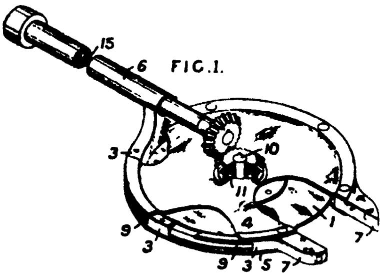

FIG. 1.

FRANCE.

MANUFACTURE OF WHITE CONSUMPTION SUGAR FROM FIRST PRODUCT RAW (BEET) SUGAR. *Theodor Drost*, of Berlin. *520,038*. July 18th, 1921.

Claim is made for a process of manufacturing white consumption sugar from first product raw by *claircage* and turbining in centrifugal machines characterized by the fact that the clairce utilized is molasses which after dilution to 74–76° Brix is mixed in the proportion of about 30 per cent. (of the weight of raw sugar) by pugging or mixing during half an hour, this pugging being effected at a low temperature, 30-35° C., so that at first the clairce is not altered by the crystalline mass, while the green syrup afterwards separates, this syrup charged with crystals and the resulting covering being centrifuged. This process of manufacture is essentially realized in using several times the molasses as clairce for treating fresh quantities of raw first product sugar, the molasses being finally treated as by-product.[1]

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[1] It is claimed by the Gesellschaft für Verwertung Drost'scher Patente, G. m. b. H., of Berlin, that this process has given the most satisfactory results in a constantly increasing number of factories. It enables beet first product massecuite to be separated at once into its two constituents, viz., (1) dry white crystal sugar of about 99·9° polarization ready for sacking; and (2) green syrup (first run-off) with a purity of 77–79°. By further using the Drost crystallizer, the after-product massecuite may also be separated into its two constituents in one single continuous operation of the centrifugal, viz.: (1) white dry sugar of 99·7° polarization, and (2) molasses with a purity of 63·0°. It is claimed that in both the first and second cases the washing is effected without the use of steam for covering, and in fact without the use of any more coal than is usual in raw sugar manufacture. Some of Drost's statements however, have been contested by Dr. CLAASSEN.

GERMANY.

TREATMENT OF SUGAR SOLUTIONS BY DECOLORIZING CARBONS, THE ELECTROLYTES PRESENT BEING PREVIOUSLY REMOVED BY OSMOSIS. *Elektro-Osmose A.-G. (Graf Schwerin Gesellschaft)*, of Berlin. *335,816*. July 22nd, 1919.

It has now been found that the efficiency of decolorizing carbons, as "Eponit," "Carboraffin," etc., is many times increased when the solution has previously been freed from electrolytes. This elimination of salts may be accomplished by dialysis, i.e., using electro-osmosis.[1] Thus, for example, it was demonstrated that when 2000 litres of juice having a colour of 2·6° Stammer were treated with "Carboraffin," a decolorization of 56 per cent. could be obtained. On the other hand, when the same juice was previously made electrolyte-free, and then treated with decolorizing carbon under the same conditions as before, a decolorizing of 100 per cent. was reached. Claim is made for the process of decolorizing coloured solutions containing electrolytes thereby characterized by previously making them electrolyte-free before the addition of the decolorizing material.

PRODUCTION OF FATS FROM CARBOHYDRATES BY MEANS OF MOULDS. *Kriegsausschluss für pflanzliche und tierische Ole u. Fette G. m. b. H.*, of Berlin. *310,616*. June 6th, 1916.

Claim is made for the process of producing fat from materials containing carbohydrates characterized by inoculating beets, potatoes, apples, pears, etc., in comminuted form with moulds of the groups *Sachsia, Oidium, Endomyces*, or with yeasts, and leaving the treated material to grow either on floors or in apparatus making provision for access of air. For example, 1200 parts by weight of chopped raw beet of 21 per cent. sucrose content were mixed with a paste containing 37 parts of brewery yeast and maintained at a temperature of 25° C. for about 24 hours. At the end of this time, it is said, the product contained about 19 per cent. of fat.

WASHING BEET SCUM CAKES IN CHAMBER OR FRAME PRESSES, USING WATER, STEAM, OR COMPRESSED AIR. *Askan Müller*, of Opocno, Czecho-Slovakia. *332,579*. July 9th, 1920. (Two claims.)

It was recently pointed out by the inventor[2] that during the filling of a press with beet scums, the sand collects in the lowest part of the cake, as the result of the shock of the pump. He therefore now makes claim for a process of washing out the sugar in scum cakes in chamber or frame presses with the help of water, steam, or compressed air, characterized by the regulation of the flow of water, etc., according to the varying porosity of the layers of cake, in order thus to realize the even distribution of the water or other medium through the whole height of the cake in the press. This he puts into practice by restricting the cross-sectional area of the water passages supplying the lowest part of the cake, that is, in those parts which, owing to their high content of sand, are more porous than the rest.

DRYING APPARATUS FOR (REFINED) SUGAR PLATES OR LOAVES. *Maschinenfabrik Grevenbroich*, of Grevenbroich, Germany. *343,925*. July 13th, 1920.

MACHINES FOR CUTTING PLATES AND BARS OF (REFINED) SUGAR. *Raffinerie Tirlemontoise*, of Tirlemont, Belgium. *342,603*; *342,604*; *342,605*; *342,606*; *342,607*. Additions to *336,245*; *327,791*; *342,606*.

PROCESS AND APPARATUS FOR THE ARRANGEMENT AND PACKING OF SUGAR IN PLATES, STRIPS, AND CUBES. *Raffinerie Tirlemontoise*, of Tirlemont, Belgium. *346,430*. December 23rd, 1920. (One figure; five claims.)

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[1] *I.S.J.*, 1920, 593; 1921, 650.

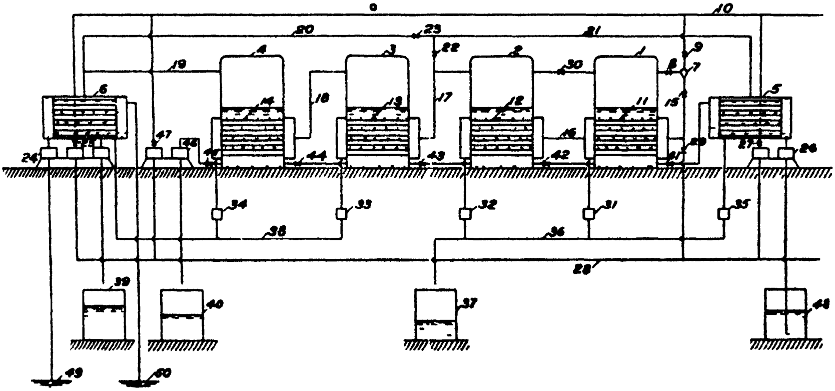
[2] *I.S.J.*, 1922, 104.

Patents.

UNITED STATES.

EVAPORATING APPARATUS, USING VAPOUR COMPRESSION. *William L. de Baufre*, of Annapolis, Maryland, U.S.A. *1,390,676*. September 13th, 1921. (One figure; five claims.)

The several evaporator shells are numbered *1*, *2*, *3*, *4*, respectively; *5* is a pre-heater and *6* a condenser. An ejector *7* is connected to withdraw through valve *8* from the evaporating chamber of shell *1* the vapour produced therein. The steam to operate ejector *7* is supplied through valve *9* from steam main *10*, and the co-mingled steam and compressed vapour passes through valve *15* into the evaporator tubes *11* which comprise the condensing chamber of shell *1* Since there is discharged from shell *1* only the vapour which is compressed in ejector *7* and returned to tubes *11*, all the co-mingled steam and compressed vapour will not be condensed therein. In fact, there must be discharged through connecting pipe *16* into tubes *12* of shell *2* nearly 1 lb of co-mingled steam and vapour for each lb of steam supplied ejector *7* through valve *9*. The condensation of the co-mingled steam and vapour in this second condensing chamber (tubes *12*) will produce nearly an equal quantity of vapour in the second evaporating chamber (shell *2*). With valve *22* closed, this vapour from shell *2* will all pass through connecting pipe *17* to the tubes of *13* of shell *3*. Shell *3* with tubes *13* thus constitutes the second effect of a multiple-effect arrangement, in which shell *2* with tubes *12* constitutes the first effect and shell *4* with tubes *14* constitutes the third effect. Shell *1* with tubes *11* may be called the "regenerative effect" of the plant. While more than three effects can be provided, the drawing shows the vapour from shell *4* passing through pipe *19* to condenser *6*. With valve *23* open, a part of the vapour from shell *4* will pass through pipes *20* and *21* to preheater *5*. Reversing the positions of valves *22* and *23* so that the feed heater is supplied with steam from the first effect rather than from the last effect, results in a higher temperature of the liquid fed to shell *1*. The co-mingled steam and vapour supplied tubes *11* may be augmented by exhaust steam through valve *29* from exhaust main *28*. Valve *30* is provided in order to allow the "regenerative effect" (shell *1*) to become a part of the first effect (shell *2*) should it be desired at times to operate the plant with valve *8* closed. The condensed steam and vapour in tubes *11*, *12*, *13*, *14*, and in preheater *5*, are discharged by traps *31*, *32*, *33*, *34*, and *35*, respectively, through drain main *36* to tank *37* or through drain main 38 to condenser *6*. The vapour condensed in condenser *6* and the condensate discharged therein are removed by pump *24* together with any non-condensible gases present, and the condensate may be stored in tank *39*. The above arrangement is suitable when the last two effects are worked under a vacuum; if worked above atmospheric pressure, the corresponding traps might discharge directly into tank *37* or tank *39*.



Pump *24* is shown as also drawing cooling water from source *49* and discharging it through condenser *6* to waste at *50*.

The liquid to be evaporated or concentrated is taken from storage tank *48* by feed pump *26* and forced through feed heater *5* into shell *1*. The rate of feed may be regulated either by pump throttle valve *27* or by feed valve *41*. From shell *1* the partially concentrated liquid passes to shell *2* through valve *42* where it is further concentrated, through valve *43* to shell *3* where it is still further concentrated, and finally to shell *4* through valve *44*, and from thence the completely concentrated liquid is drawn by pump *46* through valve *45* and discharged into storage tank *40*. It should be noted that the system is operative with a greater number than three effects, or with the "regenerative effect" and first effect only. Also, shells *1* and *2* may be combined to simplify the construction, two evaporating chambers and one condensing chamber being provided in a single shell.

Preparation of a Table Syrup containing Invert Sugar. *Henry A. Hughes*, of Haddon Heights, N.J., U.S.A. *1,402,615*. January 3rd, 1922.

Claim is made for the process which consists in adding water and an acid to granulated cane sugar; heating the mixture to about 190° F. (88° C.) for approximately half-an-hour to invert the sugar content of the solution to a polariscope reading of about zero degrees; and stopping the inversion at such reading by adding a 70 per cent. cane sugar solution at a temperature of 60° F. (15·5° C.), thereby producing a mixture having a polariscope reading between + 18 and + 22°.

Centrifugals. (1) *Philip T. Sharples*, of St. Davids, Pa., U.S.A. *1,401,196*; *1,401,197*. December 27th, 1921. (2) *Enrique A. Tonceda*, of Albany, N.Y., U.S.A. *1,401,291*. December 27th, 1921.

Filtration of Sugar Liquors. *George W. S. Simpson and Robt. F. Lyle*, of Greenock, Scotland. *1,401,199*.[1] December 27th, 1921.

Beet Harvester. (1) *Frank W. Knowles*, of Portland, Oreg., U.S.A. *1,401,413*. December 27th, 1921. (2) *Geo. W. Welton, Sr.* *1,403,929*. Jan. 17th, 1922.

Cane Harvester. *H. O. Scranton*, of Jeanerette, La., U.S.A. *1,406,093*. February 7th, 1922. (Four claims.)

Claim is made (1) in a harvester for a truck, a saw-guide supported by the truck, a reciprocating saw slidable in the said guide and projecting crosswise of the centre line of draft, guides for the standing plank projecting from the truck on each side of the centre line of draft, a stationary support for the lower ends of the cut plank arranged adjacent to the saw, and a rest for the upper end portions of the cut plank supported by the truck and arranged on the centre line of draft above and to the rear of the said saw.

Motor Fuel containing Alcohol, Petrol (Gasoline), and Kerosene. *Walter T. Schreiber* (assignor to the *U.S. Industrial Alcohol Co.*, of West Virginia). (1) *1,405,805*. (2) *1,405,806*. February 7th, 1922.

(1) Claim is made for the process which comprises dehydrating ethyl alcohol with a carbide, then collecting the cooled gaseous hydrocarbon in a quantity of gasoline and kerosene, and adding the alcohol to the gasoline and kerosene containing the absorbed hydrocarbon. (2) Claim is made for the process of making a fuel comprising the formation of a composition consisting of aqueous alcohol, a light hydrocarbon resulting from petroleum distillation, and a heavier hydrocarbon, adding to this composition calcium carbide to dehydrate it, and allowing the acetylene formed to dissolve therein, whereby a suitable composition is formed, which will not separate into its constituents at low temperatures.

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[1] Also U.K. Patent, 120,005; *I.S.J.*, 1919, 92.

Making Sorghum Syrup. *A. Hinton.* *1,403,412.* January 10th, 1922.

Strained sorghum juice (50 gallons) is boiled for 30 mins., the froth removed, 50 gallons of cold juice added, and the whole stirred and skimmed. A small quantity of baking soda is added, and after removing the precipitated impurities, the liquid is evaporated to the state of syrup.

Isolation of Fibre from Bagasse for the Purpose of Paper Manufacture. *Douglas E. Scott* (assignor to *Arthur D. Little, Inc.,* of Cambridge, Mass., U.S A.). *1,399,891.* December 13th, 1921. (No drawings; two claims.)

Bagasse as it comes from the mills is preferably (but not necessarily) submitted to a supplemental shredding operation; and charged into an apparatus designed for further minutely disintegrating the material in the presence of a relatively large proportion of water (25–50 times its weight). This apparatus must be provided with a suitable device adapted to wet screening having a mesh relatively coarse compared with that of the screens heretofore used in paper making. It should effect a reasonably perfect separation of pith and fibre. An ordinary paper mill beater, equipped with a washer, may be adapted to the purpose, the usual fine mesh wire of the washing cylinder being replaced, however, by the relatively coarse mesh just mentioned. In the case of previously shredded bagasse, treatment in the beater for about one hour usually suffices to accomplish the desired result. Then the washed fibre is ready for the cooking operation, and for the subsequent manipulations for conversion to paper of the desired quality.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1922. Tons.		1921. Tons.
Total Receipts, January 1st to April 26th	1,493,366	..	914,476
Deliveries ,, ,,	1,429,108	..	908,369
Meltings by Refiners ,, ,,	1,259,428	..	781,186
Exports of Refined ,, ,,	200,000	..	65,000
Importers' Stocks, April 26th	64,258	..	18,159
Total Stocks, April 26th	248,808	..	176,191
	1921.		1920.
Total Consumption for twelve months	4,107,328	..	4,084,672

Cuba.

Statement of Exports and Stocks of Sugar, 1919-1920, 1920-1921, and 1921-1922.

(Tons of 2,240 lbs.)	1919-20. Tons.	1920-21. Tons	1921-22 Tons.
Exports	1,307,086	767,010	818,697
Stocks	659,330	776,224	799,619
	1,966,416	1,543,234	1,618,316
Local Consumption	24,500	30,000	30,000
Receipts at Ports to March 31st	1,990,916	1,573,234	1,648,316

Havana, March 31st, 1922. J. Guma.—L. Mejer.

Sugar Market Report.

Our last report was dated 5th April, 1922.

There is no doubt that the passing of the Budget without any alteration in the existing sugar duty tariff, caused a certain amount of disappointment to the trade generally. The announcement of the excise concession to home grown sugars fostered the idea that some reduction would be made in the import duty, and growing confidence as the Budget date drew nearer, led jobbers and dealers to accumulate a certain amount of stock in anticipation of the demand which was expected to follow. It must be admitted that such stocks have not been unduly pressed upon the market and the decline in values of White sugar is not so pronounced as it might have been in view of the trade apathy which has set in, and the quiet advices which are coming to hand from America.

In the absence of Continental offerings, the importing interest centres chiefly in American Granulated, which reached 20s. 9d. May, 21s June c.i.f. U.K. ports, and is now quoted 19s. 10½d. May, 20s. 1½d. June, 20s. 3d. July, Sellers. London refiners have booked good orders to the trade and now quote London Granulated 48s. 3d. prompt, 48s. July and August; Tate's No. 1 Cubes 52s. 9d. Spot, duty paid. In W.I. Crystallized, Jamaicas on the spot are offering at 41s. to 43s. 6d. duty-paid, according to quality.

The Mauritius Syndicate sold the balance of the crystals remaining, estimated at about 35,000 tons, to English Refiners at a price equivalent to 16s. 9d. per cwt. f o.b. Calculating the preferential duty, this is equal to 13s. 9d. per cwt. c.i.f. U.K.

The present quotation of 20s. 1½d. in bond for White sugar in the Terminal market, is unchanged from a month ago, fluctuations having been registered between 19s. 10½d. and 20s. 7½d. in the meantime. Some buying interest has been observable in Oct./Dec. delivery which is quoted 19s. 1½d. after being done up to 19s. 6d.

Business in raw sugars to refiners included Cuban 96's up to 14s. 4½d. c.i.f. and back to 13s. 1½d. c.i.f., the last price reported, at which there are sellers. Taking into account the published figure of Cuban exports to the U.K. during April (126,176 tons), and the Mauritius crystals referred to above, our refiners appear to be under no pressing necessity to enter into further purchases in the immediate future.

Generally speaking prices on this side are still susceptible to movements in the American and Cuban markets. Large transactions have taken place in New York terminals, partly accounted for by operations against the active movement of Cuban stocks which is taking place; the narrowness of the limit of fluctuation in price is a remarkable indication of the readiness with which sales have been absorbed. Latest quotations 2·64 c. July and 2·84 c. September, compare with 2·76 c. and 2·93 c. respectively on the 5th April last.

A glance at the figures of the exports from Cuba will show the free manner in which the crop is being handled, and the diversity of its destinations. The price of 96° centrifugals c. & f. New York has fluctuated between 2¼ c. and 2½ c., the latter being to-day's quotation.

Total receipts in Cuba to the end of April are given as 2,264,702 tons against 2,163,704 tons last year, and 2,570,571 tons for 1920, for the same period. Latest advices state that 36 centrals in the Western part of the island have finished grinding, giving a total production of 3,553,641 bags against 3,689,000 bags as estimated by Mr. HIMELY and an actual production of 4,436,828 bags last year. It is expected that the deficiency shown by these figures will be more than compensated in the output of the centrals still grinding in the Eastern districts.

The Java market continues dull, holders being disappointed at the continued absence of enquiry from India, and there is a tendency for the premiums on early sugars to run off. That India will still require to buy considerable quantities is admitted, but it looks as though a few weeks further abstention from the market might lead sellers to modify their ideas. Quotations c. & f. Calcutta are nominally 18s. 6d. June, 18s. 4½d. July/September, the U.K. parity being about 6d. per cwt. more.

H. H. HANCOCK & Co.

10 & 11, Mincing Lane,
London, E.C. 3,
April 5th, 1922.

THE

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

British Sugar Trade Policy.

An important deputation of the sugar interests of the British Empire Producers' Organization waited on the Secretary of State for the Colonies last month to ask for an increase in the preference accorded to Empire sugars in view of the very depressed state of the industry. Elsewhere we give the remarks of the deputation and the sympathetic reply of Mr. Wood, the Under-Secretary, who represented Mr. Churchill (absent through indisposition). The Government, we gather, are fortunately alive to the importance of maintaining the sugar industry within the Empire and to the desirability of preventing any foreign monopoly of the sugar supply to this country such as largely existed before the war and undoubtedly threatens again in the not distant future from American sources. They do not for the moment see their way to increase the preference; on the other hand the fears of the producers that a reduction in the sugar duty would proportionately reduce the value of the preference has been set at rest for another year at least. The producers will have to carry on to the best of their ability with the existing preference. It would not be difficult if the price of sugar were not so low. But we think there are indications that prices will rise somewhat before very long. The ease with which Cuba has got rid of her vast surplus since the New Year suggests that consumption is developing. Certainly at present prices, the United States consumption is capable of an appreciable increase.

The American Trust Menace

Reference was made by the deputation to the attempts on the part of American sugar interests to seize the sources of production in Cuba and elsewhere and consolidate them with the American sugar refining industry in one gigantic combine to export the surplus products to European markets. We were one of the earliest in this country to draw attention to this menace, inasmuch as in our February issue we pointed out that American financial interests were prospecting in Cuba, and buying up properties there, and that the "toll scheme" was only a beginning of a sustained effort to corner Cuban sugar and refine it for the British and other European markets. At that time a morning paper came out with the rather naive report that Mincing Lane knew nothing of the matter. Probably by now Mincing Lane has heard of it, although SIR ROBERT LYLE in his recent correspondence in the *Times* over the comparatively negligible preference to home beet interests had nothing to say on the subject, nor did he think it worth urging the Government to assist the British refiners against a much more serious menace. We are glad to see that the *Times* now draws the attention of its wider circle of readers to the danger. As it remarks in a recent number of its weekly Trade Supplement, "a determined effort to gain control of the sugar trade is being made by a powerful American combination, which includes the beet and cane interests of the United States itself, and those of Cuba, Porto Rico, Santo Domingo, Haiti, the Virgin Islands, Hawaii and the Philippines. . . . The combine claims to be in a position to place at least 1,000,000 tons annually on the British market and it can of course do so at any price it cares to accept in order to destroy competition. It is common knowledge in trade circles that it also controls something over 1,000,000 tons of sugar carried over from previous seasons which it can use not only to drive British sugar producing Colonies out of business, but also to crush the British refining industry. If it is allowed to succeed in its objects the British consumer will enjoy cheap sugar for possibly two or three years and will then be compelled to pay a monopoly price, while the taxpayers of this country will have to provide large sums to make good administrative deficits in the Crown colonies that will have been brought to bankruptcy by the annihilation of one of their chief sources of wealth."

We quote the *Times* leader at some length because it expresses very succinctly the position. Not all the sugar interests in the countries referred to above are of course concerned in the matter; but the financial combine which is engineering the threatening monopoly has a footing in all these regions, and any success at the start would enable them to extend that footing till they virtually commanded the sugar production of each region. It is therefore all to the good that the *Times* has stated the facts for the benefit of that large circle of politicians and economists who always seem to resent any attempt on the part of the Government to widen the sources of supply and so discourage monopolies. There are some users of sugar in this country, for example the Co-operative Wholesale Societies (said to be the largest buyers of sugar for retail in Great Britain), who are violently opposed to the preferences accorded to Imperial and home-grown sugar. In straining out the gnat they are swallowing the camel, for if they have their way and no assistance is continued to Imperial sources of supply, it may not be long before they, or rather their millions of mostly poor customers, (in vulgar parlance) have to pay through the nose for the sugar they consume. But one fears that political myopia is no more curable than its physical counterpart, and the British sugar industry will always need to fight for its rights to share in the world's sugar production.

Monopolies are a bad thing all round except perhaps for the monopolists themselves. They restrict trade, not only the production of the object manufactured, but also the sources of supply of the raw material. In the sugar industry, for instance, not only would the number of regions where sugar is made be reduced, but the supply of all the machinery and plant required for making the "monopoly sugar" would tend to get into a few hands also, so that sugar engineering generally would suffer a setback and be restricted to the fortunate few, which would be good neither for world industry nor for invention. The more widespread is competition the greater its incentives to improvement and development, whereas, vice versa, monopoly has less need to advance with the times always providing it can control the financial situation and stave off new competition. The German Cartel monopoly was bad for the world's sugar industry, including that of cane, and any American cane sugar monopoly would be equally baneful not only for other sources but also for those Americans themselves who are not inside the combine and who desire to remain free agents and producers subject only to ordinary competition.

European Production and Consumption, 1922-23.

Our Continental Correspondent sends us for this issue a preliminary estimate of the coming European sugar beet crop, the start of which has been delayed some weeks by the cold and late spring. He believes the total sowings for 1922 will not differ materially from those of 1921, and the only other factor is the amount and the quality of the roots that will be grown and reaped from these sown areas. He is, for the moment, inclined to put the total of the European sugar production this campaign at 4,130,000 metric tons expressed as raw sugar. This amount would be available for a consumption of something like six million tons, so if these estimates prove anything like accurate it means that Continental Europe may be in the market the next twelve months for not far short of two million tons of cane sugar, which would have to be drawn from America. So far, be it observed, there are no indications of any speedy return to the pre-war output on the part of Europe. The increased competition of cereals (due to the failure of the Russian Empire to contribute its customary large supplies) and the increased cost and comparative scarcity of labour are factors which tend, and will continue to tend, to thwart the efforts to increase the output of beet sugar in Europe.

Confirmatory evidence of this shortage of sugar is given by a message to the *Times* from its Berlin correspondent on May 24th, stating that the German Ministry of Food has decided to permit the free import of sugar owing to its scarcity for domestic consumption, it being now almost unobtainable in the shops where the control price is 14 marks (2¼d.) per lb. The German sugar manufacturers have, of course, protested against this step as a danger to the German sugar industry and have declared that if foreign sugar must be admitted a gold duty of 1400 marks [? per 100 kilos] must be imposed. To this the sugar users and consumers are opposed. They consider that the shortage is due to the heavy export of German sugar and that the import will simply be German export sugar at enhanced prices.

The shortage is, of course, in the main due to the fact that the production since the war has not been enough to warrant any export of sugar from Germany if the home consumption was to be fully met. That exports have occurred will only have accentuated the shortage, so it would appear that Germany is taking a step that is probably without precedent in the history of her sugar production, in that she is proposing to admit foreign sugar free of duty.

American Domestic Crop Figures.

The final report of the beet sugar production in 1921 in the United States, as issued by the Department of Agriculture, shows that last year's crop compared less favourably with those of preceding years in the matter of yield per acre, sugar content and purity of roots, but in respect of acreage, beet tonnage and quantity of sugar produced it was second only to the 1920 crop. The beets worked up totalled 7,414,000 short tons, derived from an area of 814,988 acres and the sugar made from these came to 1,020,489 tons; these figures compare with 7,991,000 tons, 871,676 acres, and 1,089,021 tons respectively in 1920. Ninety-two factories worked as compared with 97 in 1920 and the other details were (the 1920 ones in brackets): Beets per acre, 9·10 tons (9·17); average run in days, 76 (91); average extraction per cent., 13·76 (13·63); average sugar content per cent., 15·77 (15·99); average purity per cent., 83·09 (83·96).

According to the official figures of the same Department, the 1921 sugar crop of Louisiana produced 324,431 short tons of cane sugar and 6,454,388 gallons of syrup as compared with 169,127 tons and 4,638,885 gallons in 1920. This practical doubling of the crop is attributed to a greater average yield of canes per acre which was due to abnormally good growing conditions and to the very mild winter of 1920-21. The number of factories in operation was 124 as compared with 122 in 1920 and 134 in 1918. The canes ground came to 4,180,780 short tons which averaged 155·2 lbs. of sugar per ton of cane (in 1918, 4,170,000 tons of cane averaged but 135 lbs.). The average yield of cane per acre was 18·5 tons as compared with 13·6 in 1920. The *Louisiana Planter* opines that with the very mild winter they have had again in 1921-22 and the good weather during the fall and spring plant seasons, the 1922 crop should make equal progress as compared with 1921.

British Sugar Refiners and Customs Arrangements.

At a recent Council meeting of the British Empire Producers Association, it was reported that the following arrangement had been come to with the Customs for the more ready estimation in the refineries of the amounts due from Empire sugar that had gone through the refining process. Hitherto the refiners have, it was stated, been claiming a large part of the preference to compensate them for the difficulty and delay they experienced in obtaining the money value from the Customs.

"To consider the application of the duties on sugar to the business of the refiners it is necessary to bear in mind that the whole process is carried out in Bond, and it is convenient to regard that process as constituting of three sections:—(*A*) The raw sugar warehouse; (*B*) the actual process of refining; (*C*) the refined sugar and syrup warehouse. Under the new arrangement when an amount of preferential sugar is drawn from *A* by *B* the Customs officer calculates the equivalent amount of refined sugar and permits the marking immediately in warehouse *C* of that amount of sugar as preferential; and when sugar as marked was sold out of *C* preferential amount of duty only is payable upon it. This is what is meant by the phrase 'concurrent allocation.' It will be seen from the above that the refiner obtains immediately the advantage of the preference and has no reason to complain of delay or of large sums of money locked up.

"In order to appreciate the new method it may be as well to recall the old: under the old system the whole of raw sugars drawn from warehouse *A* into the refinery *B* during a month were reckoned up proportionately; for example, three-quarters full duty, one-quarter preferential. The next step was to take the actual sugars and sugar products passed out from the refinery *B* into warehouse *C* during the same month, and to divide them in the same proportion as had been ascertained in the calculation above referred to; for example, three-quarters full duty and one-quarter preferential. The bags were then marked accordingly.

"As what came out of the refinery *B* during a stated period is by no means the same as what went into it in that period, and as these calculations were made up monthly and took some time for settlement, difficulties and anomalies arose which the new system should obviate completely."[1]

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[1] *Production and Export.*

Engineering at the British Empire Exhibition, 1924.

The British Engineers' Association has been entrusted with the task of organizing the Shipbuilding, Marine, Mechanical and General Engineering Section of the British Empire Exhibition, to be held in London in 1924. The work of organizing this important Section and allotting space therein will be controlled by a Special Committee composed of the President and Council of the Association, and a number of independent representatives of engineering industry. Within the limits of the space available—about 238,000 sq. ft.—every effort will be exerted to make the engineering exhibits representative of all that is best in modern British practice. Full particulars, plans, and forms of application for space will be available for issue at an early date. Meanwhile, enquiries should be addressed to D. A. BREMNER, Director, The British Engineers' Association, 32, Victoria Street, London, S.W. 1.

Sugar Developments in Chile.

A *Department of Overseas Trade* report on Chile says that that country is entirely dependent for sugar on her neighbour, Peru, from whom she imports some 90,000 tons annually. But the Compania Industrial y Azucarera de Tacna, with head offices in Santiago, a recently formed company, hopes, in the course of a few years, to produce in the region of Tacna in the North of Chile all the sugar required for the country's consumption. This company has been engaged in establishing the cultivation of sugar cane for the last two years. The experimental work done has shown that the soil and climate are suitable, and has resulted in the selection of varieties of sugar cane adapted to the local conditions. The insurmountable obstacle in the past has been the lack of water in the region where sugar would grow. This is now being remedied, and Congress have before them a Bill authorizing the issue of Bonds for 3,000,000 pesos in irrigation works. The company is in the market for considerable quantities of sugar plantation machinery, tenders for which have been presented by several British, German and other manufacturers, but the order has not yet been placed, as work is proceeding very slowly. There is reason to believe that fresh tenders can be presented for some considerable time yet.

Another company called Compania Azucarera Nacional (Casilla No. 303, Valdivia, Chile), is in course of formation, having in view the cultivation of sugar beet and the manufacture of beet sugar therefrom. The company intends erecting a factory on six hectares of land situated on the River Valdivia, and will cultivate beet on 300 hectares; the balance of beet required will be purchased from the shareholders, a large number of whom will grow beet for this purpose. The refinery will be installed with the latest types of machinery, which will be suitable at the same time for working cane sugar, should the beet cultivation not be successful.

Other cane sugar refineries, which have been working successfully for many years and supply most of the local trade, are :—Compania de Refineria de Azucar de Vina del Mar, Casilla No. 13, Vina del Mar, Chile ; and Compania de Refineria de Azucar de Penco, Penco, Chile. There are also 11 smaller factories producing granulated sugar only. All raw material is at present purchased in Peru.

Sugar in Guatemala.

After coffee, the chief product of Guatemala is sugar, states a British Consular report. The chief plantations cover a large area along the railway on the Pacific slope and are mostly at an altitude of about 1000 feet. The industry has grown from an export of about 5000 metric tons in 1910 to over 21,000 tons in 1920. The crop for the current season (December, 1921, to June, 1922) is estimated at 42,000 metric tons, of which half will be exported in accordance with an agreement among planters. About 80 per cent. of the sugar produced is white, that exported being of 99° polarization. As a rule 12 tons of sugar in Guatemala produce 1 ton of sugar.

In 1910 when production was on a much smaller scale the bulk of sugar went to the United States and United Kingdom in almost equal shares. Since the war, however, almost the entire crop has gone to San Francisco or New Orleans.

Guatemala is unfortunate in being dependent on the state of production in other countries (Brazil and Cuba) for the marketing of her staple products, coffee and sugar; *chicle*, the only product of which she may be said to have the monopoly, being relatively unimportant. In the last two years a good deal of capital has been put into sugar machinery (mostly British) and the Government has aided the industry, by abolishing, in 1920, the export tax and the excise duty. The principal sugar properties are seven in number, comprising Panteleon (5000 tons), Concepcion (3000 tons), El Salto (2500 tons), Baul (1500 tons), Cerritos (1500 tons), Chocola (1500) and S. Cecilia. All of these except Baul have mostly British machinery. No development is looked for during 1922 owing to the state of the market and the internal conditions of the republic; but we quite expect that in the near future further progress will be recorded.

Erratum.

In our May issue, in the first paragraph on page 239, the sentence: "Hence it is advisable . . . . worn out lands" was incorrectly rendered in transcription by some mischance, and should have read as follows: "Hence it is obviously inadvisable to plant varieties with good tonnage and poor juice, as Yellow Caledonia, B 3412, and Cavengerie on rich new lands, just as, on the contrary, it is idle to plant B 208 on poor worn out lands."

Attention is drawn to the fact that the MAXWELL BROTHERS, sons of that well-known engineer and sugar expert, the late WILLIAM MAXWELL of Java, are starting as consulting engineers and sugar technologists at 76, Elsham Road, London, W. 14. These gentlemen have had a wide and varied experience in all the principal cane sugar countries; since they took university degrees, they have in fact devoted themselves entirely to the sugar industry, and in conjunction with their late father have designed, erected and operated a number of sugar factories in various parts of the world. FRANCIS MAXWELL, M.I.Mech.E., F.C.S., best known to our readers as the author of "Sulphitation in White Sugar Manufacture," was Technical Adviser to the Credit Foncier of Mauritius, in which capacity he had the supervision of a group of sugar factories. He gained his fundamental knowledge of sugar manufacture and cane cultivation in Java, where he had the opportunity of working on different modern white sugar factories, and at the Experiment Station (Kagok); and he was also connected with the erection and operation of a large double carbonatation factory. MARIUS MAXWELL, F.C.S., after a similar training and experience, went to British India, where he was in sole charge of the erection and operation of two modern sugar factories. Both brothers are at present on the Board of Direction of several sugar companies. In view of their experience it will be agreed that these gentlemen are peculiarly qualified to advise on all matters pertaining to the sugar industry, and we wish them every success.

Fifty Years Ago.

From the "Sugar Cane," June, 1872.

The principal article in this issue of our predecessor was contributed by the Editor, Mr. ALFRED FRYER, and was entitled "Hints on the Mode of Working the Concretor"; but it contained something more than "hints," giving in fact very full details, theoretical and practical, of the operation of the apparatus. It was mentioned that "the introduction of the concretor into many of the sugar growing colonies and countries has been so rapid that up to the present time sufficient sets of plant of this apparatus have been exported to provide this country with more than a tenth of all the sugar consumed in it." As in the year 1872 the consumption of the United Kingdom was about 689,000 tons, this invention was not doing badly. Refiners readily bought this "concrete," which indeed appears to have been of better quality, on the whole, than much of the raw sugar produced at that day. Mr. FRYER had compared the concrete produced at the Belvidere factory, Antigua, with some massecuite made by one of the largest and best equipped centrals in Guadaloupe, and had found the former better in colour. "The reason is not far to seek. The syrup in the triple effet and vacuum pan has been tortured for many *hours*. . . . . and the mischief thus produced has not been counterbalanced by the double charcoal filtration. In the case of the concrete, the juice has in a few *minutes* been concentrated to the same extent and no injury whatever has been inflicted. . . . ."

Another article of some interest was a report on the Icery process, presented to the Chamber of Agriculture of Basse-Terre, Mauritius, by ARISTIDE LIGNIÈRES. On the whole the report was favourable. One of the conclusions stated that a very marked advantage in employing the process would result in the case of the large factories; but that in the small Bourbon sugar-houses the results would be better still, as it would enable them to produce the same products as the more modern installations practising double charcoal filtration. It was said that the cost of putting in the necessary new apparatus would very nearly be covered by the benefits realized during the first year.

Icery's process was carried out in the smaller factories in the following way: At the moment at which the juice flows into the grand copper, a quantity of monosulphite of lime (made on the premises with an apparatus devised by Dr. ICERY), equal to 2-3 per cent. of the juice, is added, after which evaporation was allowed to proceed as usual until the third copper was reached, Then, after the scum had been taken off as completely as possible, small quantities of milk-of-lime were added, in order to reduce the acidity to the right degree. When the juice had reached a density of 25°Bé., it was taken from the battery and placed in the subsider, from whence after the deposition of excess of sulphite and other insoluble matter it was passed into the boiling copper, and concentrated to grain. Among the advantages of this process, in addition to a good yield of fine white sugar, it was claimed that the juices and syrups contained less "glucose," and that, in fact, the sugars made were free from this constituent. Probably the control in operating the method was more precise and careful, and in consequence the amount of inversion occurring was much less than ordinarily.

Comparative Sweetness of Refined and Direct Consumption Cane Sugars.

A Reply to Mr. Geoffrey Fairrie.

By J. P. OGILVIE.

At the Lecture Hall, Y.M.C.A., Fargate, Sheffield, on March 2nd, a lecture was given by Mr. GEOFFREY FAIRRIE, in the course of which he made the following statement regarding the sweetening power of sugars:—

> "Although refined sugar is primarily a valuable foodstuff and preserving agent, its ever increasing popularity as an article of diet is also due to its great sweetening power. . . . Sweetening power is a property of refined sugar which cannot be accurately measured, but is known to bear some relation to the polarization or sucrose content. One can merely compare the sweetness of one sample of sugar with another, as one can compare the different degrees of redness of two flowers. Four taste sensations can be distinguished, viz., sweet, sour, bitter, or salt. If two of these sensations are stimulated together, one may tend to neutralize the other. Thus, a weak solution of sugar can be rendered almost tasteless by the addition of a few grains of salt. From this it becomes apparent that to get the maximum sweetening power, only the purest refined sugar should be used. . . . One should be careful not to confuse flavour with sweetness. Honey, for example, contains a mixture of dextrose and levulose, which is relatively less sweet than refined sugar, weight for weight; but it possesses a distinctive flavour, due to the presence of minute quantities of perfume derived from the flowers by the bees. Some grades of raw sugars sold for domestic consumption without purification are sometimes erroneously regarded as being sweeter than the white refined article. The pure sugar contains more sweetening matter, weight for weight, than the raw sugar, but the impurities present in the other grades give a peculiar odour and flavour, sometimes mistaken for sweetness . . . ."

Mr. FAIRRIE here raises an interesting question, one that has been discussed for many years past, not only by those directly connected with the industry, but also by the general public in almost every country. At times the point debated has been the relative sweetness of refined cane and beet sugars[1]; but Mr. Fairrie's statement (as we interpret it) is that, owing to its greater content of sucrose, refined sugar is really sweeter, weight for weight, than a cane sugar of the Demerara yellow crystal type, such as is sold for domestic consumption without previously having been refined.

We do not quite hold this view, being of the belief that these direct consumption sugars, weight for weight, when tasted in solution, are at least as sweet as the pure refined article, if not sweeter, in spite of their sucrose content being 4–5 per cent. less. In this article we intend to state a few reasons that appear very well to support our opinion, one which is widely held (apart from partisans like Mr. FAIRRIE), not only by the general public and by sugar salesmen, but also by chemists and physiologists who have given some careful consideration to the matter. Even on the Continent the opinion is held by many that these "colonial sugars" are certainly sweeter than the pure product. That they are more palatable there can be no doubt at all.

THE NATURE OF TASTE.

It is necessary to premise a few elementary facts regarding the nature of taste. On the surface of the tongue and the soft palate there are numerous papillæ, at the base or on the top of many of which are the so-called "taste buds" or "taste bulbs," these structures being the terminations of the gustatory nerve fibres. When these nerve endings come into contact with a sapid substance, vibrations or impulses are set up (possibly as the result of chemical changes in the cells), and conveyed to the taste centre of the brain.

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[1] *Sugar Cane*, 1885, 386; 1889, 11; *I.S.J.*, 1904, 312, 478.

These nerve endings are capable on excitation of giving rise to four gustatory sensations, which are broadly classified as: sweet, bitter, acid, and salt. Each of those sensations is believed by many physiologists to be caused by a specific set of nerves; in other words, the particular nerve endings producing the sensation of sweetness appear to be incapable of excitation by a bitter, an acid, or a saline substance.

How Sweetness may be Increased.

An important point to be borne in mind in this discussion is that the intensity of a gustatory sensation (sweetness, for example) may be modified when another set of nerves in the vicinity (say those producing a bitter, an acid, or a saline taste) is at the same time excited.[1] This last fact has been carefully established by carefully performed tasting experiments.

Thus it has been shown that if two solutions be prepared, the first containing 15 and the second 12 per cent. of refined sugar, and if to the latter a very small amount of quinine hydrochloride solution be added, it is possible by gradually increasing this addition to arrive at a certain concentration of the quinine salt at which most of the tasters would consider the weaker solution to be the sweeter.[2] It is also quite well known that if two solutions be made up both containing (let us say) 15 per cent. of refined sugar, and if to one about 0·1 per cent. of common salt be added, then 9 persons out of 10 tasting the two liquids would declare the solution containing the salt to be appreciably the sweeter.[3] Similar results are to be observed in the case of the addition of vegetable acids to pure sugar solutions.[4] It is of course well understood that if the amount of any of these additions is increased beyond a certain point, the bitter, the acid, or the saline taste will be detected, and become more or less apparent, the solution of sugar then certainly seeming less sweet. In view, then, of these facts we consider that Mr. FAIRRIE hardly stated the exact position of the question in his lecture when he said: "Thus a weak solution of sugar can be rendered almost tasteless by the addition of a few grains of salt, from which it becomes apparent that to get the maximum sweetening power only the purest refined sugar should be used. . . . . ."

Influence of the Cane Juice Aroma.

Another matter that bears on the discussion is that the sense of taste is certainly affected by odoriferous substances. In an authoritative textbook[5] the statement is made that if the nose be held, and the eyes shut, it is very difficult in eating to distinguish between an apple, an onion, and a potato, the three being recognized when their respective aromas are eliminated only by their texture in the mouth, and not by their "taste." The late W. H. TH. HARLOFF[6] a couple of years ago remarked that when palm sugar (which is exceedingly sweet and luscious) is dissolved in water and treated with a decolorizing carbon for the adsorption of the non-sugars, one obtains a liquid that is much less sweet than the original solution, although its content in sucrose and reducing sugars may be the same. Then a similar observation was made years ago by Mr. F. I. Scard[1] to the effect that the pure sucrose obtained by washing Demerara sugar to remove the adhering syrup and by re-crystallizing the white sugar left, appeared almost tasteless in comparison with the original crystals. These several points regarding the factors capable of influencing the sweetness of a sugar seem to be well established. Indeed they are so well recognized that the proposal has been made that traces of vegetable acids and flavouring substances should be added to pure white sugar for the purpose of increasing its sweetness and palatability as a commercial article.

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[1] HEIMANS, *Zeitsch f. Psychologie u. Physiologie d. Sinnesorgane*, Bd. XXI, 1899.

[2] ZUNTZ, *Bu Bois Raymond's Archiv f Physiologie*, 1892.

[3] KREMER, *Archives neerl. de Physiologie*, 1918, 1, 627.

[4] On the other hand, traces of alkalis lessen the sweetening effect of a solution of sugar. Dr. SEYFFART, a well-known German chemist, once said: "According to my experience, the sweetness of sugar is greater when traces of acids, especially fruit acids, are present than in solutions which, as in the case of our beet sugars, contain a trace of alkali. . . . ." It is well known anyway that Continental unrefined white sugar of low grade is appreciably less sweet than the purest refined.

[5] "A Textbook of Physiology." By SIR MICHAEL FOSTER, M D., F.R.S. Part IV. The Senses. Page 1513.

[6] *I S.J.*, 1920, 105.

Yet another factor to be mentioned, though one admittedly of less importance, is that these yellow crystal sugars[2] may contain from 1·5 to 2·0 per cent. of reducing sugars, which is a mixture of dextrose and levulose, generally regarded as being sweeter than sucrose, a recently expressed opinion, that of Prof. J. J. Willaman,[3] of the University of Minnesota, giving 100: 135 as the actual ratio.

Our conclusion from the observations cited above is that substances which undoubtedly increase the sensation of sweetness are present always in direct consumption sugars of the Demerara crystal type, and to a less extent also in plantation whites. In the first place, in such sugars there is present just the trace of acidity capable of intensifying the sweetness[4]; and in the second, they possess the delicious aroma of the cane juice, which distinctly enhances the sensation of sweetness.

TASTING TRIALS.

However, the question of the relative sweetness of Demerara yellow crystal and refined sugars is one to be decided, not by the opinion of one or two persons, but by careful trials in which the impressions of a good number of people regarding the taste of solutions[5] identified only by numbers are recorded and analysed. Toulouse and Vaschide,[6] among other investigators, have described the conditions under which such trials should be made, and have suggested a method of diluting the sapid substance and a procedure for eliciting the opinion of the individual tasters. Other workers, as Kremer,[7] have devised gustometers or saporimeters[6] for use in such experiments.

If such tasting experiments were carried out, we think there would be little doubt that the conclusion of the majority regarding the relative sweetness of the two kinds of sugars under discussion would indicate that Demerara yellow crystal sugar, weight for weight, is somewhat sweeter than the refined article, though probably after all the difference would not be a very great one. But, in any case, we believe that these yellow crystal sugars will always be relished for use on the table by reason not only of their sweetness, but also because of their palatability and their wholesomeness, and this probably in spite of the criticisms made against them by Mr. Geoffrey Fairrie.

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[1] *I.S.J.*, 1904, 478.

[2] That is of course the genuine West Indian cane sugar, and not the dyed product made in certain refineries.

[3] *I.S.J.*, 1919, 84.

[4] In their manufacture a distinctly acid reaction during boiling is a *sine qua non*.

[5] So as to eliminate the influence of important factors such as the size and hardness of the grain, and (in the case of Demerara sugars) the presence of adhering syrup, such trials would of course have to be made with solutions, and not with the various sugars in the crystalline state.

[6] *Comptes rendus*, 1900, **130**, 803; 1904, **139**, 898.

[7] *Archives néerl. de Physiologie*, 1918, **1**, 625–634.

Prospects for the Coming European Beet Crop.

(From our Continental Correspondent.)

At last the data, concerning the area sown with beets in Europe have become available; they come to hand much later than has been the case in other years, and show that no difference to speak of exists between the total European sowings of 1922 and those of 1921.

When we speak of Europe, we must necessarily exclude from our discussions the land reported to be sown with beetroot in Russia. Just as in 1921, the authorities there have ordered the sowing of 200,000 desjatins, and on paper that area has been propared and sown; but in reality only half the acreage planted in 1921 has born fruit and the tonnage of that remnant was so exceedingly bad, that we are inclined to speak of a total failure instead of a crop.

We do not know how matters will be this year, but we believe that no real improvement will be met with this time, so that we prefer to refrain from discussing Russia in these observations and restrict ourselves to the other countries, where the sugar industry still is under the rule of the capitalist system, and does not enjoy the blessings (?) of communism.

Mr. LICHT puts down the area sown in the European countries, save Russia in 1922 at 1,170,000 hectares, against at 1,129,188, or about 1 per cent. more this year. Of course, these figures are not the final ones, so that we need not take notice of that increase of 1 per cent.; it may become more or it may prove less, but we do not expect any great changes.

Spring has come very late this year, in fact it was not till the middle of May that the cold north easterly winds stopped chilling us and drying up the fields. Consequently any sowing of beets and germination of the young plants was considerably delayed; but that same delay has had the advantage that no young beets have been frozen and nothing has had to be resown on that account. Further, we have heard nothing of great damage done to winter crops, which might have necessitated resowing the land with beets, so that, after all, the acreage originally destined for beet cultivation will be pretty well the final one.

Contrary to expectations ventilated during the last few months to the effect that the European sugar industry would make strenuous efforts to come back to something like its pre-war magnitude, it can be seen that only a very slow recovery is being made from war's blows and, in 1922-23 likewise, the combined European output will remain unable to supply the wants of that part of the world. Several causes contribute to this. Once on a time the great food producer, the Russian Empire does not now send wheat, rye and barley to Western Europe, and even cries for aid towards supplying her own wants; the price for cereals in European countries is hence so high that it pays much better to grow these than sugar beets. In the second place, beets require a great deal of labour during almost the whole period of their growth and in these days, when labour is expensive and scarce, many a farmer does not want to grow more beets than he is obliged to do by the claims of his system of crop rotation or by the need of cattle food for his stock. In the third place, the sudden drop in sugar prices since last year has brought financial loss to many a sugar manufacturer who had contracted for beets at the time when the price was high and promised profit; for when he had to sell his sugar extracted from these beets, the price of the article had come down, thus yielding a severe loss for the result instead of profit. No wonder that under such circumstances manufacturers have since tried to fix the price of beets on a basis which would depend to a large extent on the price of sugar, so as to avoid losses by fluctuations in the world's price. Lengthy negotiations between growers and manufacturers have occupied both parties during the winter months, but now the contracts have been signed, and the beets are sown we must hope that bright sunshine and copious rainfall will alternate so as to raise a fine crop of high-polarizing roots in the autumn.

Although spring has come late and the beets are about three weeks behind, as compared with normal years, yet a moist summer and a dry and warm autumn may easily make up for the difference and cause the beets to yield a good crop. Last year the summer and autumn were very dry, to the detriment of the tonnage and the sugar content of the beets in most European countries. For that reason the output per acre was not satisfactory in 1921/22, and one hopes that 1922/23 will show better returns. It is still much too early to say anything definite on the subject, but we are inclined to estimate the coming European beet sugar crop, taking the totals of all countries, except Russia, at 4,130,000 metric tons raw value, distributed amongst the various countries as follows :—

Germany	1,500,000	Switzerland..	5,000
Czecho-Slovakia	600,000	Spain	150,000
Austria..	20,000	Denmark	130,000
Hungary	60,000	Sweden	140,000
Poland	200,000	Bulgaria	15,000
Netherlands	275,000	Yugo-Slavia	35,000
Belgium	275,000	Rumania	40,000
France	425,000	United Kingdom	10,000
Italy	250,000		
		Total Europe (except Russia) ..	4,130,000

Since the European consumption, equally exclusive of Russia, may be put down at something like six million tons raw value per annum, it is obvious that in 1922/23 Europe will continue to import large amounts of Sugar from other parts of the world and chiefly from the Western hemisphere, either as raw sugar from the Antilles and West Indies or in the shape of refined sugar from the United States.

The *West India Committee Circular* states that the Imperial Government has now definitely agreed to contribute the sum of £15,000 towards the funds of the West Indian Agricultural College in Trinidad. This grant is to be spread over five years and there are certain conditions attaching to it, the most important being that the Governing Body shall maintain the functions of the Imperial Department of Agriculture (which will now be merged in the College organization). The principal of the college will in future discharge the duties of Commissioner of Agriculture.

A corporation has been organized under the name of the United States Syrup Co. to operate H. C. Cutler's process[1] of making a table syrup from beet molasses, it being claimed that this product is equal to the ordinary table molasses on the market. It is claimed that 100 gallons of syrup can be made from 1 ton of beet molasses at a cost of not more than $10, so that at a wholesale price for the syrup of 50 cents per gallon, the return is a very good one. Mr. Cutler is chemist to the Utah-Idaho Sugar Co., and the President of the Syrup Co., is Mr. Thos. R. Cutler, who is also vice-president of the Utah-Idaho Sugar Co. In brief, Mr. Cutler's process consists in hydrolysing with acid 5–60 per cent. of the sugar in the beet molasses, dialysing to remove the salts, boiling to eliminate volatile and albuminoid impurities, filtering, and evaporating to the state of syrup.

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[1] U.K. patent 169,113 ; *I.S.J.*, 1921, 706.

Sugar Preferences.

British Empire Producers' Deputation to the Colonial Office.

An important Deputation representative of the Sugar Producers throughout the Empire, introduced by Mr. **BEN H. MORGAN**, Chairman of Council of the British Empire Producers' Organization, waited upon the Hon. E. F. L. Wood, Under-Secretary of State for the Colonies, on May 11th, to ask for an increase in the Preference accorded to Empire sugars in view of the very depressed state of the industry. The following constituted the Deputation :—Australian Sugar Producers (Col. **OLDERSHAW**) ; Australian Sugar Producers' Association (**CHAS. MCNEIL**) ; British Empire Sugar Machinery Manufacturers' Association (**W. SCOTT HERRIOT**) ; British Sugar Beet Growers' Society (**F. FRENCH KEMP**) ; Canadian Beet Sugar Industry (**W. C. NOXON**) ; Empire Development Parliamentary Committee (**ALFRED BIGLAND**) ; Indian Sugar Producers' Association (**A. D. JACKSON**) ; Mauritius Chamber of Agriculture (**L. SOUCHON**) ; Mauritius Chamber of Commerce (**J. W. HOLLWAY**) ; Royal Colonial Institute, Trade and Industry Committee (The Hon. **J. G. JENKINS**) ; South African Sugar Association (**W. J. MIRRLEES**) ; West India Sugar Industry (**A. W. FARQUHARSON**).

Mr. **MORGAN**, outlining the general position, said that sugar was the staple industry of many Crown Colonies, the financial liabilities of which fell on the Imperial Exchequer. The extent, therefore, to which this industry might decline would be the measure of increased responsibility which must fall on the British taxpayer. The market price of sugar to-day was actually below the cost of production, and if some extraordinary measures were not taken without delay to deal with the situation, numerous sugar estates would go out of cultivation ; and sugar estates take several years to restore to a normal condition of cultivation. This retrograde movement had started notwithstanding the fact that the Empire supply was far short of the Empire demand. In 1913, of a total sugar import of 1,971,282 tons excluding molasses, only 71,739 tons were imported from within the British Empire ; in 1920, though European sugars were only available in very small quantities, and though the figures include 227,075 tons of Mauritius crystals, the Empire share was only 322,899 tons out of a total of 1,363,078 tons. Before the war the middle-European sugar industry under the Cartel system provided the great bulk of United Kingdom imports, sending to this country 1,297,907 tons out of the total of 1,971,282 tons. During the war, sugar producing countries under American influence developed with extraordinary rapidity, and even after war conditions had ceased they sent in 1920 over 500,000 tons out of the total of 1,363,078 tons imported. The Empire producer is now faced with the re-organization of his old competitor in Central Europe, rapidly and secretly preparing to attack this market, and the newly-organized American industry, in which American financial interests have taken advantage of the depression in sugar to seize the sources of production and consolidate them, with the American refining industry, into one gigantic combine, to export the surplus products of this combine, which in its home markets is ringed round with protection. The American group (consisting of United States Beet, Louisiana and Texas Cane, Hawaii, Porto Rico, Philippines, Santo Domingo, Hayti, the Virgin Islands, and Cuba) produced in 1898, 1,156,000 tons of sugar, in 1913, 4,288,000 tons, in 1921, 6,454,000 tons.

At a superficial view it may appear that all this foreign development would provide cheap sugar for the British consumer. This, however, would not be the result; the cheapness would be temporary and intended to destroy the Empire industry. The effects of such destruction upon the taxpayer and consumer here would be: (1) The foreigner having obtained control of the market would fix his own prices and the consumer here would pay dearly in perpetuity for the fleeting advantage of two or three years of low prices. (2) The consequent poverty of the sugar-producing colonies would deprive the British manufacturer of a large amount of his oversea custom; not to mention the disastrous political effect on Empire relationships. (3) The loss of a very large amount of British capital invested in sugar plantations and factories oversea. (4) Other industries in the countries affected would be sympathetically depressed, and as her tropical products are entirely necessary to the prosperity of the British Empire, this would re-act vitally on Great Britain and her industries.

It is highly probable that increased production would lower the price to the consumer and so stimulate demand that what is lost in revenue by reduction in rate might be made up by increase in volume. The Crown Colonies and Dominions have been stimulated to give the largest margin of preference to goods imported into their territories from the Mother Country, and nearly all have responded, some give a preference of as much as 50 per cent. of their tariff. The sugar-producing Crown Colonies have been particularly ready to favour the productions of the United Kingdom, and last year the British West Indies and British Guiana alone gave large preferences, larger than we are now asking for, on goods to the value of about £5,000,000, a sum which roughly represented our purchases of sugar and rum. In that way they helped us to find a market for our goods and employment for our people. We can only keep those markets alive by helping to keep their staple industry on its feet, and in making this further concession in the way of preference we shall in the long run benefit employment and trade in the United Kingdom.

The introducer then called upon representatives of the industry from various parts of the Empire to state the case as it applied to their particular countries.

Mr. FARQUHARSON, representing the sugar interests of the West Indian Colonies, referred to Mr. Wood's recent visit and strongly emphasized the condition into which the sugar-planting industry would fall unless receiving substantial and speedy support at the hands of the Imperial Government. Mr. FARQUHARSON mentioned the loyalty of the West Indian colonists, and pointed out the bad effect of their coming to regard American influence as making for prosperity and opulence and British influence as causing penury and uncertainty.

Mr. MCNEIL and COLONEL OLDERSHAW spoke on behalf of the Australian industry and pointed out that an increased preference would enable it to add to the supplies of this country from Empire sources, but that without an increase of the kind it was hardly probable that it could be compassed.

Mr. MIRRLEES on behalf of South Africa spoke of the development of the industry in Natal and explained that they had exported 50,000 tons of sugar to Great Britain last year, but, in the present state of the industry, could not increase that amount and would most probably diminish it unless further encouragement in the way of preferences were given.

Mr. SOUCHON, C.B.E., and Mr. HOLLWAY, on behalf of Mauritius, mentioned that that colony had been the most important source of Empire supply to Great Britain during the War, and that a large amount of orders which would come to this country from planters there if increase and security of preference were given had to be held over owing to the effect of present conditions.

Mr. W. SCOTT HERRIOT on behalf of the British sugar machinery manufacturing industry in Great Britain pointed out that the sugar industry in our colonies created a great demand for goods from this country not only directly in sugar machinery and the contributory industries dealing with power, special appliances, and so forth, but in agricultural implements, tractors, bags, and a numerous variety of other commodities, so that many thousands of employees in Great Britain depended for their livelihood on the prosperity of the sugar industry. He pointed out that from all sugar-producing countries under American influence British machinery was practically excluded.

Mr. French Kemp on behalf of the British beet industry said that it regarded itself as part of an Empire system and urgently believed in the vital necessity of increased preference being given to the Oversea Empire producers.

Mr. Wood replying to the deputation said that he was glad of the opportunity to have heard the case of the sugar industry put so fully by so exceedingly representative a deputation, able to speak with authority on the subject. He expressed the very great regret of the Secretary of State, that owing to an unfortunate accident and doctor's orders to rest, he was unable to receive the deputation himself. Mr. Wood stated that he could not claim the deep familiarity with the subject which the deputation kindly attributed to him, but he could claim to have devoted very great efforts to become familiar with it in the West Indies, and to have given it very thorough consideration since his return. In essentials the sugar problem was one and the same throughout the Empire in spite of local variations. He wanted the deputation to realise that His Majesty's Government fully realised the important place held by sugar in all those parts of the Empire where it was the staple crop. He was fully alive to the importance, from the United Kingdom point of view, both of the prosperity of sugar proprietors as taxpayers to the Imperial Exchequer, and also to the very great degree in which employment in this country was affected by the state of the sugar industry. Comparative figures of trade with foreign countries and within the Empire emphasized the value and importance of inter-Imperial Trade. He also mentioned another argument which he said was a political one, but a very strong factor in the case, namely, that the sugar industry was to a most important degree a carrier of British influence, and where it became uneconomic British influence would automatically suffer a severe blow. Moreover, there was no possible doubt that the danger to the consumer, if foreign control of a necessity of life were ever effectively established, would be infinitely greater than anything he would be likely to suffer from the preferential policy.

Mr. Wood referred to the fact that his report on his West Indian tour would be published in a fortnight or three weeks; in this he endeavoured to represent the case of the sugar industry as it had been placed before him in the West Indies, but, beyond an indication of sympathy, he could not at the moment anticipate his report. He pointed out that the position of the Chancellor of the Exchequer was difficult, as he had to adjust the competing claims of equally valid competing demands. He recognized the strength of the argument advanced by the Colonies that had given preference to Great Britain, largely impelled by the representations of the Imperial Government. The Government had not seen their way to double the Preference, but they had promised to continue the existing rate of Preference (one-sixth of the gross duty) for a period of 10 years; and, as far as the money value went, by not reducing the gross duty the Government had, at least for one year, left that value undiminished. This was a concession of great value in that it afforded ground for confidence that would directly assist all those who depended for their livelihood upon the industry. Mr. Wood further alluded to the general hope of better conditions which he said must also have a beneficial effect on the sugar industry. He also alluded to the effects of the duty on rum upon the industry.

Birmingham (Alabama) Meeting of the Sugar Section of the American Chemical Society.

The Spring meeting of the American Chemical Society took place this year at Birmingham, Alabama. During April 3rd to 7th, the sugar section held sessions at which 18 papers were read and discussed. Short abstracts of some of these contributions are here presented, and it is hoped later to give a more lengthy account of some.

The Moisture Absorptive Power of Different Sugars and Carbohydrates. ***C. A. Browne.***—Comparisons were made of the water absorptive power of anhydrous dextrose, levulose, rhamnose, sucrose, maltose, lactose, raffinose, starch, cellulose, mannite, invert sugar, honey, molasses, malt syrup, commercial glucose and agar under different conditions of atmospheric humidity. The substances of greatest absorptive power at the end of one hour's exposure (at 20°C., 60 per cent. relative humidity) were: starch (1·04 per cent.), cellulose (0·89 per cent.), agar (0·88 per cent.) and of least absorptive power, dextrose (0·07 per cent.), mannite (0·06 per cent.), sucrose (0·04 per cent.). At the end of nine days' exposure the substances of greatest absorptive power were: agar (20·34 per cent.), starch (12·98 per cent.), raffinose (12·90 per cent.) and of least absorptive power, dextrose (0·07 per cent.), mannite (0·05 per cent.), sucrose (0·03 per cent.). At the end of 25 days' exposure at 20°C. and 100 per cent. humidity, the substances of highest absorptive power were: invert sugar (76·58 per cent.), honey (74·10 per cent.), levulose (73·39 per cent.); and of lowest absorptive power, cellulose (12·57 per cent.), lactose (1·38 per cent.), and mannite (0·42 per cent.). The presence of levulose increases water absorptive power, but the latter is not proportional to the levulose content. The absorptive power of the substances was lowest in February and highest in July and August. The natural fluctuations noted from some substances were: levulose, 11·19 — 36·31; invert sugar, 11·81 — 34·73; agar, 21·00 — 30·74; starch, 12·29 — 18·41; cellulose, 5·06 — 10·89; maltose, 5·46 — 9·37; mannite, 0·22 — 0·52. The general tendency of sugars is to absorb moisture up to the amount necessary to form a stable hydrate form.

The Observance of Mutarotation in the Polarization of Raw Cane Sugar. ***M. H. Wiley.***—Mutarotation to the extent of several tenths of a sugar degree was observed in two samples of Cuban raw sugar which had been subjected to the following conditions:—(*a*) Deterioration resulting in the formation of considerable invert sugar; and (*b*) drying-out.

Colour Values of High-grade Sugars. ***W. B. Newkirk and H. H. Peters.***—The absorption and transmittancies of 204 high-class sugars were determined for yellow, green, and violet mercury light, using a Stammer colorimeter which had been modified in such a manner that it was practically a spectro-photometer. The Stammer colour plate was entirely dispensed with and a rotating sector disc was used in its place. The average results of various classes of sugars were plotted in various ways.

The Determination of Gums in Raw Sugars. ***H. T. Ruff and J. R. Withrow.***—Of the various methods described in the literature, precipitation with alcohol in the presence of HCl was the only one which gave concordant results. The authors apparently did not consider the method of dialysis.

Control of Reaction in Sugar-house (and Refinery) Liquors. ***J. F. Brewster and W. G. Raines, Jr.***—No matter what clarifying agent be used in the clarification of cane juice, there is always obtained upon concentration to syrup a precipitate changing in quantity and composition according to the cleanness of the cane and the method of clarification.

Sugar Purity Determinations. ***W. D. Horne.***—Great numbers of sugar purity determinations having to be made daily for the chemical control of sugar factories and refineries, a very rapid and accurate method has been evolved by means of special appliances. A Brix spindle containing a complete temperature correction scale gives a corrected Brix for any density and temperature. Defecation with "dry lead" is practically instantaneous and more accurate than by the use of lead solution. From the Brix and the polarization thus obtained, one finds the purity on a table printed on movable rolls easily exposing the desired portion.

Modifications in the Use and Application of the Hess-Ives Tint Photometer. ***H. H. Peters and F. P. Phelps.***—This paper discusses tint photometric analysis of sugar products from the standpoint of quantitative spectro-photometric analysis, which will be employed by the authors in their impending investigation of the problem of colour in the sugar industry. The same coloured solution was examined by both methods, and in layers of definite thickness. In addition to the Hess-Ives colour plate, various Wratten light filters were used in connexion with white light. It is pointed out that special lamps (for instance, a mercury vapour lamp in place of white light) may advantageously be employed with special light filters in place of the Hess-Ives three fundamental colours (red, green, and blue), for instance, mercury yellow, green, and violet. One then obtains scale readings (per cent. transmittancy), which, interpreted as negative logarithms, refer to definite wave lengths instead of to broad spectral bands. The colour values of the Hess-Ives plate and of several Wratten filters were plotted as transmittancies and luminosities, which were also given for Stammer standard colour plates, Stammer's ulmine solution, and various sugar products. Their absorption graphs were given also.

Manufacture of Plantation Standard Granulated Sugar with and without Activated Char. ***C. E. Coates.***—An outline is given of the various methods for making standard granulated sugar in the sugar-house, including: (1) Its manufacture direct from the cane without the use of char, using sulphitation or carbonatation of the juice; (2) The no-chemical process using heat and kieselguhr, the clear juice being given immediately a char filtration; (3) Making carbonatated or sulphited syrup, which syrup is subjected directly to a char filtration; and (4) The manufacture of 96° test sugar as usual and immediately remelting and treating the melted sugars with char. Much improvement has been made during the last few years, both in quality of product and in yield. Dr. COATES recommends a regular raw sugar plant plus a refining plant consisting of either a simplified boneblack plant costing $50,000, without a building; or an activated char building costing $25,000. The latter figure includes an $8000 furnace, filter-presses and mixers, but no pans. These figures were for a ·1200-ton house. COATES believes that activated char will displace boneblack if certain minor difficulties, such as channeling in the filter-presses during washing, are overcome. Char should be purchased on specification. The cost of recovery by chemical and furnace treatment is about $15·00 per ton. It can be used 30 to 40 times on melted raw sugar. The recovery method should consist of acid washing, followed by furnace treatment. If the order of these steps is reversed, the char will retain adsorbed HCl, which cannot be washed out and which will cause inversion. He believes any properly prepared carbon will work well and would be willing in the present state of our knowledge to take a chance on the char plant described above. The carbon should not cost over 7½ cents, with boneblack at 5 cents per lb. 25 per cent. more molasses is produced by the use of activated char than with boneblack. Four Louisiana houses are now using activated char, two of which are refining Cuban raw sugars. They all make raw sugar, melt and refine, treating with Norit. Guanica is making good sugar by the carbonatation process, but has high losses. The kieselguhr-Norit process is not a commercial success because the sugar is sometimes off colour and because the kieselguhr cannot be regenerated, and its use is therefore too expensive.

Adsorption of Colour and Ash by Decolorizing Carbons and by Animal Charcoal (Boneblack). ***W. D. Horne.***—While a number of very good decolorizing carbons have been developed, they generally lack the power to adsorb ash, which is of great importance in sugar refining. Experiments show that it is the mineral framework of boneblack which adsorbs most of the ash taken up in its use. Calculations show that a carbon deficient in ash-adsorbing power could scarcely compete economically with boneblack in refining. Encouraging results in ash as well as colour adsorption were obtained with an artificial boneblack formed by the fixation of carbon on a porous earthy substratum. The attention of investigators is invited in this direction.

Precipitate formed in Sugar-house Syrups. ***J. F. Brewster and W. G. Raines, Jr.*** A precipitate forming in the syrup of cane sugar factories interferes seriously with the production of good white sugar. Analysis showed this to be mainly inorganic, and to consist of silica, sulphuric and sulphurous acids, lime and other bases. In some cases large amounts of iron were present. Dr. COATES in discussion stated that the only method he has been able to recommend to eliminate this precipitate is sedimentation. That the precipitate may be due largely, or in part, to colloidal clay carried through the process is indicated by the fact that experiments have shown it to decrease in amount when the cane is washed.

Improved Precision Refractometer. ***W. P. Valentine.***—An improved instrument in which great interest for the sugar industry was taken by all present, the chief developments being as follows:—(1) By using glass of lower refractive index in the Amici prisms, a sector of the same radius carries, within the same length of arc, only the portion of the usual refractometric scale needed for sugar work. The scale is therefore more spread out, and allows of finer sub-division than in the old instrument. As soon as the Bureau of Standards is able to furnish conversion values for another decimal place, the author will be ready to provide a sugar scale with sub-divisions for every one-tenth per cent. (2) Longer telescopes and improved systems of magnification; also the elimination of any parallax. (3) Improved mechanical features, such as double support for telescope to prevent it from getting out of adjustment with the rest of the instrument, and elimination of friction in the alidade pivot. Easy access of parts. The joint committee appointed at the Rochester meeting to establish new refractometric tables did not make a report. Dr. FREDERICK BATES discussed the difficulties involved in this work, which has been undertaken by the Bureau of Standards, and stated that it had been found necessary, for such a fundamental investigation, to design and build new and more accurate experimental apparatus. He stated that accurate temperature control is of fundamental importance, and the work will therefore take more time than had been anticipated.

Preparation of Adonitol. ***R. S. Black.***—Crystalline adonitol is prepared by extracting *Adonis vernalis* plants with hot water, defecating the expressed liquid by first adding aluminium sulphate solution followed by an excess of slaked lime until precipitation is complete. The yellow precipitate is removed by filtering upon a suction filter. The filtrate is concentrated *in vacuo* to a thin syrup when basic lead acetate is added, filtered, the excess lead removed, concentrated to a syrup, and alcohol added. At this point a little phosphoric acid added to the alcoholic solution throws out more impurities, and aids in the subsequent crystallization. The alcoholic solution is evaporated to a thick syrup and taken up in an equal volume of 95 per cent. alcohol, is "seeded," is allowed to crystallize, then is recrystallized from 95 per cent. alcohol.

Milling Plant Performance Estimations.

By P. H. PARR.

(*Continued from page 257.*)

EXTRACTION RESULTS.

We now come to the third section of the subject, the extraction results. The author, for the estimation of milling extraction results, usually allows for the bagasse from the first mill (no crushers), containing 35 per cent. of fibre, 40 per cent. from the second mill, 45 from the third, and 47 from the fourth and succeeding mills. When preceded by a crusher, 2 per cent. may be added to the first three, giving 37, 42, 47. . . A shredder about the same as a crusher. Two crushers probably, say, 38, 43, 47. . . Cane knives, say 36, 41, 46, 47. . . Actually, the bagasse from the earlier mills is lower in fibre content as the milling train is longer (about 34-35 per cent. from the first mill of a 14-roll set), and the quantity of cane milled increased, but in the absence of special information, the above assumptions give reasonable average results. Some milling plants work the final bagasse to 50 per cent. fibre, and even over—the author has figures up to 56·6 per cent. from an 11-roll train milling 13 per cent. fibre cane, with 10 per cent. dilution—but these are exceptional: the average bagasse from over fifty large factories—many of them centrals—in different parts of the world, works out to 46·0 per cent. fibre and 4·5 per cent. polarization, so that the 47 per cent. adopted seems to be reasonable for average good working.

In an article by the present author on the "Extraction of Sugar Cane Mills," in the *Engineer* for February 16th, 1917, a table was given of the calculated extractions for the various milling trains, on the above-mentioned fibre basis for the bagasse, for both simple and compound imbibition, the amount of imbibition water supplied being reckoned at 8 per cent. on the cane for each intermediate carrier, which is a reasonable average; and these extraction figures—which allow for a "mixing factor" of 0·9—have been used as the basis for the following tables. By simple imbibition is of course meant that working where the imbibition water is applied in equal amounts to each intermediate carrier, the mill juices all going direct to the factory; and by compound imbibition, that where all of the water is applied to the last intermediate carrier, the juices from the later mills being passed back in succession to the earlier carriers, and the juices going to the factory from the first two mills only.

To illustrate the method of obtaining the figures given in the accompanying tables, consider, say, an 11-roll milling plant, with simple imbibition of 16 per cent. on the cane, milling cane with 12 per cent. fibre, for which the extraction was given in the article quoted above as 91·7 per cent. The amount of normal juice in the cane being 100 — 12 = 88 per cent., the extracted normal juice will be $88 \times 0{\cdot}917 = 80{\cdot}7$ per cent. of the cane. The bagasse, having 47 per cent. fibre, will amount to $12/0{\cdot}47 = 25{\cdot}5$ per cent. of the cane, and will contain juice equal to $25{\cdot}5 \times (1 - 0{\cdot}47)$ or $25{\cdot}5 - 12 = 13{\cdot}5$ per cent. of the cane: the extracted mixed juice will therefore be (juice in cane) + (imbibition water) — (juice in bagasse) $= 88 + 16 - 13{\cdot}5 = 90{\cdot}5$ per cent. of the cane. The Brix of the normal juice being taken at 18, that of the mixed juice will be $18 \times 80{\cdot}7/90{\cdot}5 = 16{\cdot}1$, with a density of 10·64 lbs. per gallon. The gallons of mixed juice per ton of cane will be $2240 \times 0{\cdot}905/10{\cdot}64 = 190$. The sugar in the bagasse is that not extracted from the cane, and is therefore $88 \times 0{\cdot}18 \times (1 - 0{\cdot}917) = 1{\cdot}31$ per cent. of the cane, and as the bagasse is 25·5 per cent. of the cane, the sugar percentage in the bagasse is $1{\cdot}31/0{\cdot}255 = 5{\cdot}1$. The composition of the bagasse is thus 47 per cent. fibre, 5·1 per cent. sugar, and 47·9 per cent. water. If the normal juice is of 85 per cent. purity, the 5·1 per cent. "sugar" in the bagasse will mean $5{\cdot}1 \times 0{\cdot}85 = 4{\cdot}3$ per cent polarization, the other 0·8 per cent. being solids other than sucrose.

The heat units available for evaporation in the boilers, per lb. of bagasse, have been calculated from the formula:—

$$\text{B.T.U.} = 6735 \times \text{fibre} + 6158 \times \text{sugar} - 1237$$

as given in the article by the author on the "Calorific Value of Bagasse" on page 15 of this Journal for January, 1922, corresponding to waste gases at 500° F., and the lbs. of water evaporated by the bagasse from one ton of cane have been found by allowing 130 B.T.U. per lb. of steam, which corresponds to a feed water temperature of about 90° F. for the usual sugar factory steam pressures, the allowance evidently being liberal.

Tables V and VI give the calculated extraction and bagasse figures for simple and compound imbibition respectively, with canes of 10, 12, and 14 per cent. fibre content. The Brix of the normal juice has been assumed at 18 in all cases: the Brix of the mixed juice, and the sugar percentage in the bagasse, will vary directly with the Brix of the normal juice, so that for, say, an 8-roll mill on 10 per cent. fibre cane, with normal juice at 16 Brix, the mixed juice will be $17{\cdot}1 \times 16/18 = 15{\cdot}2$ Brix, and the bagasse will contain $7{\cdot}4 \times 16/18 = 6{\cdot}6$ per cent. of sugar, and $7{\cdot}4 - 6{\cdot}6 = 0{\cdot}8$ per cent. extra water, or a total of 51·4 per cent. water. The "sugar" tabulated as in the bagasse really refers to the solids in the juice, or assumes a purity of 100 per cent.: with normal juice at 85 per cent. purity, the polarization of the bagasse will of course be only 85 per cent of the tabulated figures, the difference of 15 per cent. being solids other than sucrose, but which may be treated as sugar so far as calorific values are concerned. It might at first sight be thought that the multiplier for the sucrose in the bagasse ought to be the purity of the last mill juice, instead of that of the normal juice mentioned, but when it is considered that the method of calculation has been to find the percentage of the normal juice not extracted, and therefore remaining in the bagasse, it will be seen that the purity of the normal juice is the correct figure to use. What really happens is that, if a bagasse contains 5 per cent. sugar as calculated from the normal juice with an assumed purity of 100, while the actual purity of the normal juice is 85, and that of the last mill juice 70; then the polarization of the bagasse will be $5 \times 0{\cdot}85 = 4{\cdot}25$ per cent., the solids in solution in the juice in the bagasse will be $4{\cdot}25/0{\cdot}70 = 6{\cdot}07$ per cent. instead of the 5 per cent. mentioned, and the water content will be reduced 1·07 per cent, so as to balance at 100 per cent. These differences are of minor importance for calorific values, but the corrections to any particular case can readily be made, as indicated, if the probable bagasse analysis is desired to be known with accuracy. The other figures of the tables are not affected by the Brix or purity of the normal juice.

Table V.

SIMPLE IMBIBITION.

				MIXED JUICE.			BAGASSE.					
No. of Rolls.	Imbibition per cent. cane.	Extraction per cent. sugar	N J. per cent. cane.	Per cent. cane.	Gall/ton cane.	Brix.	Per cent. cane.	Per cent. fibre.	Per cent. sugar.	Per cent. water.	B.T.U /lb.	Lb. evaporation per ton cane.
10 per cent. Fibre.												
3	0	79·3	71·4	71·4	150	18·0	28·6	35·0	11·7	53·3	1841	1044
5	0	81·1	72·9	72·9	153	18·0	27·0	37·0	11·3	51·7	1951	1044
6	8	87·9	79·1	83·0	174	17·2	25·0	40·0	7·8	52·2	1937	982
8	8	89·1	80·2	84·2	177	17·1	23·8	42·0	7·4	50·6	2041	963
9	16	93·2	83·9	93·8	197	16·1	22·2	45·0	5·0	50·0	2102	925
11	16	93·9	84·5	94·7	199	16·0	21·3	47·0	4·6	48·4	2212	934
12	24	95·6	86·0	102·7	216	15·1	21·3	47·0	3·4	49·6	2138	903
14	24	95·9	86·3	102·7	216	15·1	21·3	47·0	3·1	49·9	2119	895
15	32	96·9	87·2	110·7	234	14·2	21·3	47·0	2·4	50·6	2076	877
17	32	97·0	87·3	110·7	234	14·2	21·3	47·0	2·3	50·7	2070	874
18	40	97·7	87·9	118·7	252	13·4	21·3	47·0	1·7	51·3	2033	858
20	40	97·8	88·0	118·7	252	13·4	21.3	47·0	1·7	51·3	2033	858
12 per cent. Fibre.												
3	0	74·7	65·7	65·7	137	18·0	34·3	35·0	11·7	53·3	1841	1252
5	0	76·8	67·6	67·6	141	18·0	32·5	37·0	11·3	51·7	1951	1257
7	8	84·4	74·3	78·0	163	17.1	30·0	40·0	8·2	51·8	1962	1167
8	8	85·9	75·6	79·4	166	17·1	28·6	42·0	7·8	50·2	2072	1175
9	16	90·7	79·8	89·3	188	16·1	26·7	45·0	5·5	49·5	2132	1128
11	16	91·7	80·7	90·5	190	16·1	25·5	47·0	5·1	47·9	2243	1134
12	24	93·9	82·6	98·5	207	15·1	25·5	47·0	3·8	49·2	2162	1093
14	24	94·2	82·9	98·5	207	15·1	25·5	47·0	3·6	49·4	2150	1087
15	32	95·6	84·1	106·5	225	14·2	25·5	47·0	2·7	50·3	2095	1059
17	32	95·9	84·4	106·5	225	14·2	25·5	47·0	2·5	50·5	2082	1052
18	40	96·7	85 1	114·5	243	13·4	25·5	47·0	2·0	51·0	2052	1037
20	40	96·8	85·2	114·5	243	13·4	25·5	47·0	2·0	51·0	2052	1037
14 per cent. Fibre.												
3	0	69·8	60·0	60·0	125	18·0	40·0	35·0	11·7	53·3	1841	1460
5	0	72·4	62·3	62·3	130	18·0	37·8	37·0	11·3	51·7	1951	1462
6	8	80·8	69·5	73·0	153	17·1	35·0	40·0	8·5	51·5	1980	1374
8	8	82·6	71·0	74·6	156	17·2	33·4	42·0	8·1	49·9	2090	1384
9	16	88·1	75·8	84·9	178	16·1	31·1	45·0	5 9	49·1	2157	1330
11	16	89·4	76·9	86·2	181	16·1	29·8	47·0	5·5	47·5	2267	1339
12	24	91·9	79·0	94·2	198	15·1	29·8	47·0	4·2	48·8	2187	1292
14	24	92·3	79·4	94·2	198	15·2	29·8	47·0	4·0	49·0	2175	1285
15	32	94·0	80·8	102·2	216	14·2	29·8	47·0	3·1	49·9	2119	1252
17	32	94·3	81·1	102·2	216	14·3	29·8	47·0	3·0	50·0	2113	1248
18	40	95·4	82·0	110·2	234	13·4	29·8	47·0	2·4	50.6	2076	1226
20	40	95·5	82·1	110·2	234	13·4	29·8	47·0	2·3	50·7	2070	1223

Table VI.

COMPOUND IMBIBITION.

				MIXED JUICE.			BAGASSE.					
No. of rolls.	Imbibition per ce	Extraction per ce	N.J. per cent ca	Per cent. cane.	Gall/ton cane.	Brix.	Per cent. cane.	Per cent. fibre.	Per cent. sugar.	Per cent. water.	B T.U./lb.	Lb. evaporation per ton cane.
10 per cent. Fibre.												
9	16	94·8	85·3	93·8	197	16·4	22·2	45·0	3·8	51·2	2028	892
11	16	95·4	85·9	94·7	199	16·3	21·3	47·0	3·5	49·5	2144	905
12	24	97·8	88·0	102·7	216	15·4	21·3	47·0	1·6	51·4	2027	856
14	24	97·9	88·1	102·7	216	15·4	21·3	47·0	1·6	51·4	2027	856
15	32	98·6	88·7	110·7	234	14·5	21·3	47·0	1·1	51·9	1996	843
17	32	98·6	88·7	110·7	234	14·5	21·3	47·0	1·1	51·9	1996	843
18	40	98·8	88·9	118·7	252	13·5	21·3	47·0	0·9	52·1	1984	838
20	40	98·8	88·9	118·7	252	13·5	21·3	47·0	0·9	52·1	1984	838
12 per cent. Fibre.												
9	16	92·7	81·6	89·3	188	16·4	26·7	45·0	4·3	50·7	2059	1090
11	16	93·7	82·5	90·5	190	16·4	25·5	47·0	3·9	49·1	2169	1096
12	24	96·7	85·1	98·5	207	15·5	25·5	47·0	2·0	51·0	2052	1037
14	24	96·8	85·2	98·5	207	15·5	25·5	47·0	2·0	51·0	2052	1037
15	32	98·0	86·2	106·5	225	14·6	25·5	47·0	1·2	51·8	2002	1012
17	32	98·1	86·3	106·5	225	14·6	25·5	47·0	1·2	51·8	2002	1012
18	40	98·4	86·6	114·5	243	13·6	25·5	47·0	1·0	52·0	1990	1006
20	40	98·4	86·6	114·5	243	13·6	25·5	47·0	1·0	52·0	1990	1006
14 per cent. Fibre.												
9	16	90·3	77·7	84·9	178	16·5	31·1	45·0	4·8	50·2	2089	1288
11	16	91·5	78·7	86·2	181	16·5	29·8	47·0	4·4	48·6	2199	1299
12	24	95·4	82·0	94·2	198	15·7	29·8	47·0	2·3	50·7	2070	1223
14	24	95·5	82·1	94·2	198	15·7	29·8	47·0	2·3	50·7	2070	1223
15	32	97·3	83·7	102·2	216	14·7	29·8	47·0	1·4	51·6	2015	1190
17	32	97·4	83·8	102·2	216	14·7	29·8	47·0	1·4	51·6	2015	1190
18	40	98·0	84·3	110·2	234	13·7	29·8	47·0	1·0	52·0	1990	1176
20	40	98·0	84·3	110·2	234	13·7	29·8	47·0	1·0	52·0	1990	1176

It is interesting to note that for the 22-roll plant of the earlier example, milling 64 tons of 12 per cent. fibre cane per hour, with compound imbibition, the steam produced per hour will be 64 × 1006 = , say, 64,000 lbs., of which the cane engines will consume 44,500 lbs., or say 70 per cent. This percentage of the total steam generation—from the bagasse—required by the cane engines is not appreciably affected by the fibre percentage in the cane, but is, of course, affected by the number of rolls, and by the boiler pressure: with an 11-roll train, and the same 120 lbs. per sq. in. boiler pressure, the cane engines require about 46 per cent. of the steam generated by the bagasse.

It is frequently desirable to know quickly, the effects of amounts of imbibition water different from those adopted as a basis for the tables, and usually a close approximation can rapidly be found as follows: Let E_0 be the extraction with dry crushing to bagasse of the same fibre content, and E_1 the tabular extraction with W_1, the tabular amount of imbibition water; also, let the corresponding amounts lost in the bagasse be $L_0 = 100 - E_0$ and $L_1 = 100 - E$: then with imbibition water of W per cent. on the cane, the extraction will be approximately $E = 100 - L$, where—

$$L = \frac{W_1 L_0 L_1}{W_1 L_1 + W (L_0 - L_1)} \quad \cdots \quad (4)$$

The values of E_0 the extraction with dry crushing to the final bagasse fibre content adopted by the author, are :—

N	10	12	14 per cent. fibre.
3	79·3	74·7	69·8
5	81·1	76·8	72·4
6	83·4	79·5	75·6
8	84·7	81·0	77·5
9	86·5	83·3	80·0
11	87·5	84·6	81·5

and the figures for 11-rolls, with bagasse of 47 per cent. fibre, apply to all greater numbers of rolls.

As an example, consider an 11-roll train, milling 12 per cent. fibre cane with compound imbibition. From the above, $E_0 = 84{\cdot}6$, giving $L_0 = 100 - 84{\cdot}6 = 15{\cdot}4$. From table VI, $W_1 = 16$ and $E_1 = 93{\cdot}7$, giving $L_1 = 100 - 93{\cdot}7 = 6{\cdot}3$; then, according to formula (4), the loss with imbibition of W per cent. on the cane will be :—

$$L = \frac{16 \times 15{\cdot}4 \times 6{\cdot}3}{16 \times 6{\cdot}3 + W (15{\cdot}4 - 6{\cdot}3)} = \frac{1550}{101 + 9{\cdot}1 W}$$

Putting the imbibition water W = 10, 20, and 30 per cent. of the cane then gives losses L of 8·1, 5·5, and 4·1 per cent., or extractions of 91·9, 94·5, and 95·9 per cent. respectively, whilst the extractions calculated *ab initio* by the method given in the *Engineer* article are 91·5, 94·6, and 96·0 per cent. respectively, the differences being small in this case. Mathematically, formula (4) is equivalent to assuming that the curve connecting extraction with imbibition is a rectangular hyperbola, passing through the two known points for zero and for W_1 imbibitions, and asymptotic to 100 per cent. extraction. For final work, especially with small quantities of imbibition water, it may be advisable to check over the extractions obtained in this manner by the *Engineer* method, but the use of the present tables and the interpolation formula (4) will be found to be sufficient for nearly all practical purposes if W is not less than half W_1 : for a 14-roll train with 10 per cent. imbibition, the interpolation method gives an extraction about 1 per cent. too high, and for longer trains and low imbibitions, the differences may be greater, but it is not often that such cases occur.

In some cases, both with factory control results and in specifications, inbibition is specified as a percentage dilution of the normal juice, instead of as a percentage of the weight of the cane, and this method of definition leads to a series of calculations which, though not difficult, give some engineers a lot of trouble, whilst mistakes may readily be made unless the underlying principles of mixtures are kept clearly in mind. As a fair example, consider a milling plant working cane of 10 per cent. fibre and 90 per cent. juice at 16 Brix : the extraction to be 96 per cent., the dilution 15 per cent. on the normal juice, and the final bagasse to have 50 per cent. fibre. The extracted normal juice will evidently be 90 ×

0·96 = 86·4 per cent. of the cane, while normal juice equal to 90 — 86·4 = 3·6 per cent. of the cane will remain in the bagasse. The bagasse will amount to 10/0·50 = 20 per cent. of the cane, so that the normal juice in it will amount for 3·6/0·20 = 18 per cent.: this being of 16 Brix, will give 18 × 0·16 = 2·9 per cent. sugar (solids), and the bagasse will therefore have the composition 50 per cent. fibre, 2·9 per cent. sugar, and 47·1 per cent. water; or if the normal juice be of 85 purity, and the last mill juice of 70 purity, the polarization of the bagasse will be 2·9 × 0·85 = 2·5 per cent., and the solids in solution will be 2·5/0·70 = 3·6 per cent., giving 3·6 — 2·5 = 1·1 per cent. of solids other than sucrose: the bagasse will, therefore, finally analyse 50 per cent. fibre, 2·5 per cent. sucrose, 1·1 per cent. other solids, and 46·4 per cent. water. The Brix of the mixed juice will of course be 16 × 100/115 = 13·9, with a density of 10·55 lbs. per gallon: the amount will be 86·4 × 1·15 = 99·5 per cent. of the cane, or 2240 × 0·995/10·55 = 211 gallons per ton of cane. The imbibition water, being 15 per cent. on the normal juice, will be 15 × 0·90 = 13·5 per cent. on the cane: and so on.

For the fibre percentages in the bagasse adopted above, that is, 37, 42, 47, . . for mills preceded by a crusher, and with 12 per cent. fibre in the cane, careful calculations bring out the interesting facts that, theoretically, for a train with four mills, the highest extraction should be obtained by working the first two mills dry, when the imbibition is less than 21 per cent. on the cane, and by working with three wet crushing mills when the imbibition is higher. For a 5-mill train, the highest extractions ought to be obtained with three dry and two wet mills for imbibitions less than 12 per cent.; with two dry and three wet mills for imbibitions between 12 and 33 per cent.; and with four wet mills for higher imbibitions. For a 6-mill train, the highest extractions ought to be obtained with three dry and three wet mills for imbibitions less than 18 per cent.; with two dry and four wet mills with imbibitions between 18 and 38 per cent.; and with five wet mills for higher imbibitions. The corresponding figures for other percentages of fibre in the cane have not been worked out, but will, no doubt, follow closely the amount of residual juice in the bagasse, which again follows the fibre in the cane, so that the imbibition percentages may be taken as directly proportional to the fibre in the cane, and, for example, with a 6-mill train, with 10 per cent. fibre cane there should be three dry mills up to 18 × 10/12 = 15 per cent. imbibition, and then two dry mills up to 38 × 10/12 = 32 per cent. imbibition, and so on. These figures depend on calculations made for simple imbibition, but those for compound imbibition are not likely to be greatly different. In all cases, the more efficient the dry crushing, before the application of any imbibition at all, the higher should be the extraction.

The author believes that the formulæ and tables given with this article offer a reasonably fair representation of average practice, and they should at any rate be of considerable value for comparative purposes, even if some of the absolute values are open to criticism. The tables cover the complete range of standard sizes and combinations of milling trains, worked out on a uniform basis, and they are far more complete than any others that the author has ever seen; whilst the present is probably the first time that a rational and consistent method has been suggested for estimating the power requirements of compound milling trains. When criticizing, it should be remembered that the intention has not been in any degree to illustrate the best results obtained in the highest grade practice, but rather the average working of an ordinary factory, in good condition and under efficient control.

Anti-Friction Bearings as an Aid to Sugar Machinery.

(Contributed.)

As in other industries, the engineering side of sugar manufacture has had increasing attention focussed upon it, with the important object always in view of obtaining maximum production at lowest cost. In the past much consideration has been given to the question of preventing re-absorption of the juice during the crushing of the cane, while comparatively little specialized investigation on power saving has been carried out. Auxiliary machinery has also been improved upon, but in such work the amount of power taken has been considered as of a secondary nature. This is readily understood when it is realized that the fuel used as the source of power is bagasse. As is only too well known to many manufacturers, the amount of bagasse available from the cane crushed is insufficient for the supply of the power requirements of the factory, necessitating the use of more or less supplementary fuel, as wood or oil. Moreover, to-day there are promising projects on foot for the utilization of the bagasse, which give this material a possibly greater value than it would possess as a fuel only.

The logical step, therefore, is to reduce the amount of power required by investigating the possibilities of increased efficiency of each part of the plant, and applying the results to ensure that this efficiency is secured. One method by which such desirable conditions may be achieved is the judicious use of anti-friction bearings, either of the ball or roller types, according to the nature of the duty. In other branches of engineering the utility of these units is recognized as a feature of increasing importance for any heavy work, for not only is economy of power effected, but many troubles attending the use of plain bearings, and the heavy costs of repairs or replacements, may be eliminated.

Ball or roller bearings are now appreciated more than formerly for their great value in these respects, but while the designer will confidently make use of them in designs for service at home, he may debate the advisability of using them for machines going abroad, particularly when such machines are to be worked by unskilled labour, as in the case of sugar machinery.

In this connexion it is interesting to know that Dr. HEERWAGEN, nearly 20 years ago, carefully investigated the question and adopted ball bearings for pumps at the Horcajo Lead Mines in Spain. He did so on the ground that:—"The inexperienced men whom he had to rely on could better be trusted with ball bearings than with ordinary bearings, which quickly resent any want of attention."[1]

The subject has been greatly developed since that time, while wide experience of a most valuable kind has been obtained. The data collected give ample evidence of the reliability of such bearings, and prove beyond doubt that practically all unsuccessful applications have resulted from: (1) Improper selection of type; (2) incorrect mountings; (3) insufficient protection.

With regard to (1) a certain amount of care has to be exercised in the selection of the proper type. The particular bearing finally decided upon must have characteristics suiting it to the conditions with which it has to deal. The standard types of bearings on the market may be classified as: (*a*) Single-row bearings; (*b*) double-row self-aligning bearings; (*c*) cylindrical roller bearings; (*d*) double-row self-aligning roller bearings.

These constitute the chief and most efficient types. The single-row type is suitable where the machining is accurate and where there is little or no whip on the shafts. If of the type having no filling slot, then they are very suitable for dealing with thrust duty, provided, of course, that the amount comes within their capacity.

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[1] *Vide Engineer* for December 26th, 1902.

In most machines, however, there is a certain amount of bending of the shafts, and in line shafting particularly this may be considerable. The double-row self-aligning bearing (*b*), as illustrated in Fig. 1, is then the first choice.

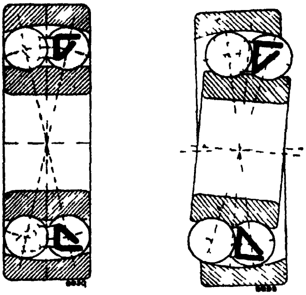

FIG 1
DOUBLE-ROW SELF-ALIGNING BALL BEARING

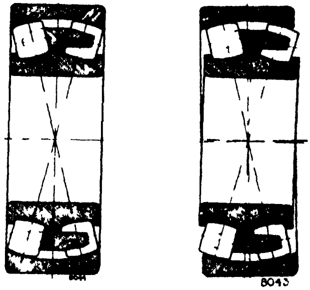

FIG 2
DOUBLE ROW SELF-ALIGNING ROLLER BEARING

In dealing with the heavier classes of machinery roller bearings may be required, and Fig. 2 shows the latest development, which has characteristics similar to the ball bearings shown on Fig. 1. This design has been developed with the object of dealing with particularly heavy duty, and during the past few years its ability to stand up under severe conditions has been abundantly proved.

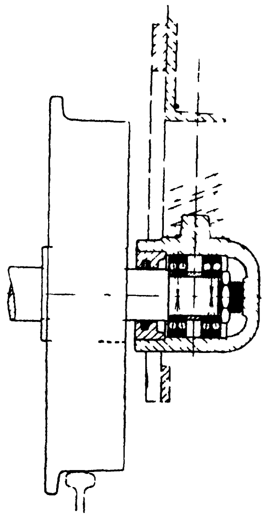

FIG 3.
SECTION OF CANE TRUCK AXLE BOX

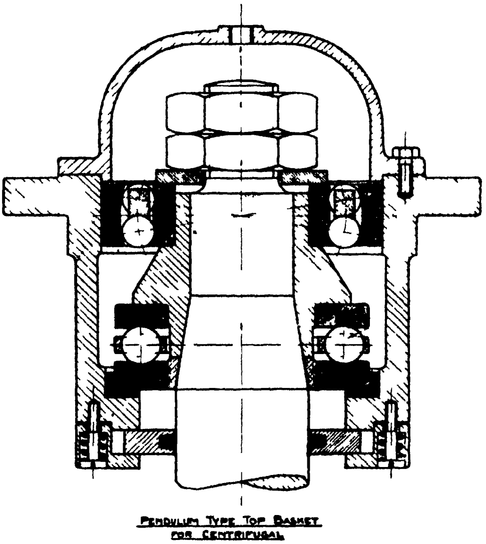

FIG. 4.
PENDULUM TYPE TOP BASKET

Anti-Friction Bearings as an Aid to Sugar Machinery.

The most attractive use for this type of bearing is found in the sugar crushing rolls. Here the journals are of abnormally large diameters, and the loads to be dealt with are very heavy indeed. The anti-friction engineer has repeatedly returned to this interesting, though somewhat difficult problem, and it is another example of the great steps which have been taken in recent years that the fitting of roller bearings is now quite a practicable thing, and it only remains to make it attractive commercially. Heavy loads at high speeds have already been dealt with in different types of machines. With cane crushers it is a case of much heavier loads at very low speeds. While the greater saving in power, oil, etc., makes the application to the crusher rolls, or Krajewski crushers, most tempting, the auxiliary machinery deserves very careful notice. Fig. 3 shows an application which has been carried out on a large scale to sugar cane trucks, and which has brought about considerable reduction in the maintenance charges due to the efficient running.

Fig. 4 illustrates a very efficient type of mounting for the top basket of centrifugals. This complete unit is self-aligning, and is held greatly in favour in certain countries. This design allows for the free swinging motion of the vertical spindle, the only difficulty being to prevent same from oscillating too much should the material in the pan cause a slight out-of-balance effect. This, however, can be readily prevented, and native labour is easily educated to watch this point.

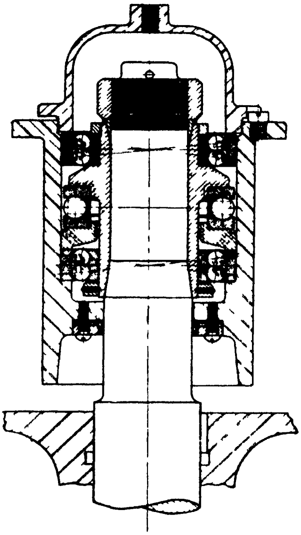

Fig. 5.—Rigid Type Top Basket.

In other quarters the "Pendulum" design is not favoured, and here the arrangement made use of is as shown on Fig. 5, or a modification thereof. This provides for a rigid bearing scheme, and while it means that out-of-balance effect will put heavy radial load on the bearing, a great number have been fitted exactly in this fashion, and have given no trouble whatever.

The above remarks are of a somewhat general character, and only a few illustrations have been shown, but it is worth while for the plant engineer to look into the possibilities of applying bearings to cane conveyors, crystallizers, pumps, electric motors, etc., etc., and it is well to keep in mind that while the initial costs may be slightly higher than with the ordinary plain bearings, their value is inobtaining economy during continuous operation. Low initial cost with high maintenance charges is recognized by all progressive engineers to-day to be poor economy.

Early last January Mr. D. J. Lewis, jun., Engineer and Sales Agent of the Cresson-Morris Co., of Philadelphia, secured a contract from the Société des Raffineries et Sucreries Say, of Paris, for four of his firm's direct electric-driven centrifugals, equipped with 48 in. × 24 in. special self-discharging baskets. These baskets are identical in design with those supplied by the Cresson-Morris Co. to the new refinery at Crockett, California, of the California and Hawaiian Sugar Refining Company, the centrifugals of which, though of the Watson-Laidlaw type, were built at Philadelphia;[1] and they are now known as Lewis baskets. The order for Paris was executed in the Cresson-Morris shops in a little over three months.

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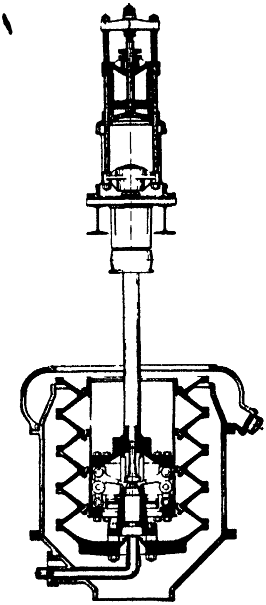
[1] See *I.S.J.*, 1921, 617; and 1922, 153.

The Mauss Continuous Centrifugal Separator.

A description of the construction of the Mauss continuous centrifugal separator has already been given in these columns;[1] and it is now of some interest to give an account of some satisfactory trials that have recently been made at the Sezela Factory, Natal, where a battery of three of these machines has worked during the last crop treating 2000 gallons raw juice per hour.

In these tests, conducted under the supervision of Dr. WILLIAM ARTHUR CALDECOTT, D.Sc., F.C.S., the raw juice, after passing through the ordinary mill strainer, had a density of 18·12° Brix, and contained 3·81 parts by weight of suspended solids on 1000 parts juice. After being passed through the Mauss continuous separators, it was found that the suspended solids left in the juice amounted to only 0·13 parts per 1000. Therefore, 96·6 per cent. of the suspended solids had been removed.



It is obvious that the figure of 3·81 parts of suspended solids, or whatever it may be, depends on the excellence of mill work and the fineness of the mesh of the mill strainer, so that the real measure of the value of the Mauss separator is the amount of suspended solids left in the juice after treatment. The low amount of 0·13 parts per 1000 realized in the trial under consideration could not be obtained by any practical method of screening.

The impurities ordinarily left in the juice affect the subsequent treatment not only in proportion to their weight, but rather to their nature. Fine particles of fibre are partially soluble, and the smaller the particle the more easily is it dissolved, so that it is of importance to remove the finer particles as well as the coarser from the juice.

The tests referred to above took place in the latter part of December, 1921, at the end of the crop when the juice—from the Uba cane—contained a large proportion of gums and was difficult to treat. Yet the separated juice contained only 0·13 per 1000 of suspended solids. The purity of raw juice was 87·9°; while the purity of the separated juice was 88·6°, showing that the separator removed more impurities from the juice than could be done by screening.

The machines referred to above were installed as an experimental plant; but the proprietors of Sezela Factory were so impressed by the performance of the Mauss separators during the crop, that they ordered a complete outfit of standard separators to handle all the juice produced.

As may be seen from the sectional illustration, the apparatus consists of a series of double conical drums, which revolve on a vertical spindle carried on ball bearings. The spindle is hollow and contains an internal spindle which is attached at its top end to a hydraulic piston, and at the bottom end operates toggle levers which open and close the drum sections. This movement of opening and closing is controlled by a timing gear which can be set to give the cycle of operations required for the liquid treated. The liquid to be treated is introduced through the central feed pipe into the bottom drum while the machine is revolving and flows upward, filling all the drums. Centrifugal action throws the heavy particles to the periphery of the conical drums and the cleared liquor is decanted over the top lip of the top drum into a circular gutter on the casing, from which it is conducted through a pipe.

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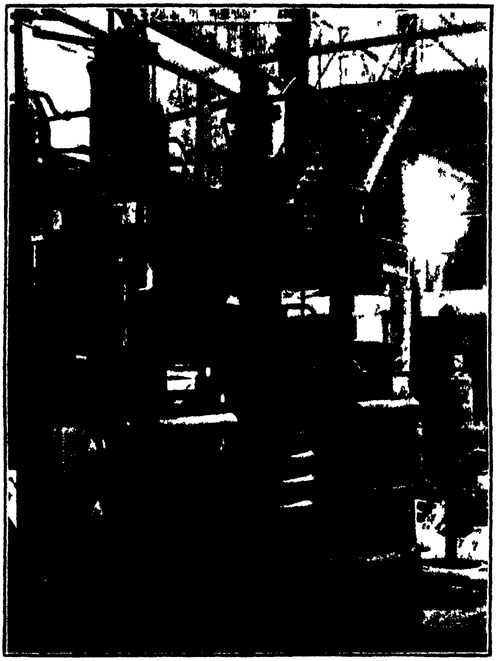
[1] *I.S.J.*, 1921, 592.



When sufficient solids have been accumulated in the drums, the flow of liquor is automatically stopped by the timing gear, water is admitted to displace most of the liquor in the drums, if necessary, and the drums are separated from each other by the toggle gear. The solids are then discharged by centrifugal force into the casing, and fall from this into a conveyor suitable for their removal. The timing gear now operates the toggle gear to re-close the drums, turns on the muddy liquor, and the cycle is complete.

The machine runs continuously, and all operations are completely automatic. Drive is by belt from motor or countershaft; and the speed is 1000 to 1200 revs. per min. The standard machine is made with conical drums having a maximum internal diam. of 28½ in., the drums being of gunmetal or cast steel.

The sole rights in the Mauss Separators have been acquired by Messrs. Duncan Stewart & Co., Ltd., Glasgow, who are now manufacturing a number of the machines.

According to a statement reported in the *Australian Sugar Journal*, the wages paid in Queensland during 1921 in the sugar industry amounted to £6,000,000, and altogether something like 20,000 men were employed, of whom 4000 came from the southern states to Queensland for four to six months in the year to get employment.

Recent Work in Cane Agriculture.

SUGAR CANE EXPERIMENTS IN THE LEEWARD ISLANDS. Report on Experiments conducted in Antigua, St. Kitts-Nevis, and Montserrat in the Season 1919-20. Barbados, 1921.

The lines laid down for the sugar cane experiments in the Leeward Islands were referred to in our review of the Report for 1918-19.[1] It was noted there that, owing to the difficulty in obtaining the requisite artificial manures, the part dealing with them has been more or less coming to a standstill, but we see from the present Report that they are still being held in view and the permanent plots are being kept up with such applications of their appropriate manures as are obtainable. In the circumstances Part II, dealing with the manurial experiments with sugar cane, is reduced this year to the small compass of four pages. Part I, on the other hand, dealing with experiments with varieties of cane, is fully maintained and is gradually expanding, especially in Nevis and Montserrat. There are a number of minor changes to be noted. In the general list, giving the botanical descriptions of all the canes grown on the experimental stations, as is natural, some canes are dropped and others added. The additions are A 410, A 1270, A 1245, and White Tanna; while B 254, B 3675, B 6346, D 74, D 625, Uba, A 592, and M 03/90 are left out, presumably owing to some defect in their commercial growth in the islands.

The export of sugar is about the same as in the previous year. This strikes one as curious, because of the considerable improvement in the weather conditions and the much greater yields of pounds of sucrose in juice in the varietal plots, both plants and ratoons, for Antigua, and we are led to assume that this difference will only make itself felt in the following year.

An interesting feature of the Report is the considerable change taking place year by year in the order of merit of the varieties, founded on the yields of the different canes experimented with, showing the importance of the tables giving the results in those varieties grown for longer periods (13 and 19 years in Antigua), in which tables the order is unaltered in the two years, with the exceptions of D 74 and D 625 omitted as shown above. As one example, the varieties which, on six different stations, have been placed in the first third among those grown, may be noted, together with the number of stations (in brackets) in which they were thus placed in the preceding year:—B 3922 (5), B 4452 (4), B 4934 (5), B 3412 (2), Sealy Seedling (3), B 4596 (5). Another example may be drawn from the list drawn up each year of the best 12 varieties, judging by their mean yield on all the stations, again in Antigua placed in their order of merit this year as compared with their position in the previous year:—B 6308 (1), B 3922 (2), B 4934 (3), B 4596 (7), B 156 (13), Sealy Seedling (17), B 6388 (4), B 3405 (9), B 3412 (22), B 4452 (5), BH 10 (12) (15), B 6032 (34). While the first three have retained their positions it is seen that the others have materially altered theirs. It will be remembered that great importance is attached to this list of 12, in that a special paragraph is drawn up for each giving its history and characters.

THE GENESIS OF A FERTILE SOIL. *J. B. Harrison. West Indian Bulletin, XVIII, 3, 1920.*

This deals with the origin of the red soils of the higher level in Barbados about which a large literature has been gradually built up. The author gives an exhaustive résumé of this, including his remarks in the "Geology of Barbados," written in collaboration with A. J. JUKES-BROWNE, which commence thus:—"In the coral area the most remarkable soil is certainly the red clay or loam which occurs on all the higher parts of the area. This is thickest on the very highest plateau above 900 ft.; below 800 ft. it is much thinner, and it does not reach below 500 ft.; indeed, between 500 and 700 ft. it becomes rather a yellow clay. . . . With regard to the origin of the red soil, we have no doubt that it has been produced by the gradual disintegration and solution of the coral-rock itself." And this in spite of the purity of the white limestone with "generally less than 2 per cent. of silica and silicates and only a minute quantity of oxide of iron." After the eruption in 1902 of the Soufrière of St. Vincent, HARRISON quotes GEORGE HUGHES as suggesting that Barbados derived its soil, at any rate in part, from volcanic dust which on analysis proves to be rich in the constituents which would form a red earth of clayey nature, and regrets that he paid so little attention to this suggestion. For, after a series of exhaustive studies extending over many years, the details of which are set out in great length in the body of the paper, the author now agrees with HUGHES' suggestion and concludes with the following: "I trust that this paper not only clearly indicates the origin, directly or indirectly, of the Barbados soils from the air-borne débris of the volcanoes of St. Vincent and possibly other vents of the West Indian volcanic province, but recalls to many of the members of the Barbados Agricultural Society the marked scientific acumen of its Consulting Chemist, GEORGE HUGHES, F.C.S., to which Barbadians were so deeply indebted for the great increase which took place in their sugar crops during the decade 1880-1890." This determination is of special interest from the much wider distribution of red soils of a similar character in Porto Rico and Cuba.

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[1] *I.S.J.*, 1921, pp. 334, 449.

REPORT OF THE COMMITTEE ON FORESTRY. *Hawaiian Sugar Planters Association, for the year ending September 30th, 1921. Honolulu, 1921.*

The Committee confines itself to the problem of conserving the remaining forests on the watersheds and reafforesting the denuded areas on them, as "the advantages and profits in planting trees on waste land in the cultivated areas have been sufficiently demonstrated to require no further discussion." The department of Botany and Forestry of the H.S.P.A. has under way two projects in Hawaii and one in Oahu, and is developing one on the slopes of West Maui mountains. Each of these is financed by the sugar estates directly interested in the water supply. The Department is prepared to direct or advise regarding any additional projects on all the more important watersheds of the islands, and the Territorial Board of Agricultural and Forestry is engaged in actively fencing forest reserves on some of the islands. A number of letters from members of the Committee to the President are added to this brief Report, some of the details of which are here extracted.

(1) C. S. JUDD, Superintendent of the Territorial Forestry Department, writes that he is busily engaged in Hawaii in converting "paper forest reserves" into actually protected ones, adding new areas, surveying, marking, fencing and removing cattle. The chief essential at present is to fence and keep out cattle and this is being actively pushed on. Tree planting is slow and expensive and, in the present financial stringency, it is considered better to work out the kinds of trees best suited to the different tracts and to proceed with the fencing, as "more afforestation can be accomplished by aiding nature in this manner than by expending thousands of dollars for artificial tree planting." He congratulates the H.S.P.A. on its Forestry Division and offers to support it by all the assistance that

the State Department can give. Meantime, he suggests that the forestry officers should be whole time and not also charged with sugar cane work, that they should be given complete control, that where adjoining estates have contiguous areas they should pool these areas and carry out a common policy, and where these interlace with the State reserves they might unite them and thus form blocks which might be handed over with advantage to the Territorial Board because of its advantages in policing, and lastly that fuel reserves should be created wherever possible. He mentions a concern which expends some $198,000 yearly in purchasing fuel for its labourers, whereas if one quarter of that sum were expended on fuel reserves it would be self-supporting in five years. It would even be a paying proposition to devote 20 acres of land under sugar for this purpose unless some cheaper source of fuel could be discovered.

(2) R. A. HUTCHINSON deals with the windward side of Hawaii. It has been shown that within comparatively recent times the whole of this important sugar tract was backed by forest and that numerous rivers flowed continuously throughout the year. Now the northern half has only dry streams which hold no water excepting after heavy rains, and it has been observed that this condition is gradually extending to the southern half, even threatening the neighbourhood of the important town of Hilo, its fluming of canes, water power, and even the water needed for domestic purposes. The planters are alive to this danger and have agreed to a voluntary cess for fighting against the evil. 2000 acres are to be added to the Hilo reserve and the whole reserve is to be enclosed with a stout stock-proof fence. A nursery has been founded which already is distributing numbers of Eucalyptus and iron woods, and further north wind-breaks and fuel reserves have been laid down, the sides of the gulches of the dry rivers are being tackled and wherever there is space trees are being put down. WM. CAMPSIE, of Pahala, reports that planting of *Eucalyptus robusta* is progressing, but more slowly than could be desired. In 1920, 32,320 were planted out and, up to August in 1921, 24,730, figures showing the scale on which these operations are considered necessary. D. McH. FORBES, of Hilo, states that the recently awakened interest in tree planting is showing evident signs of improvement. He urges the importance of conserving and improving the water supply and, after that, of selecting varieties such as cedars, Cryptomeria, Araucaria, and pines for future lumber supply. Millions of cub. ft. of lumber are annually imported into the islands at a vast cost, but if this side of the question were attacked there would in 30 years be a very considerable improvement.

(3) In Maui, H. B. PENHALLOW writes that a considerable amount of tree planting is being done privately by sugar planters, but that the local mountain slopes are especially in danger owing to their steepness, the sharpness of the ridges and the character of the soil. Active measures are being taken to prevent the cutting of trails which in time result in land slides. An experimental nursery has been established for tree planting and some progress has already been made. In one place a large number of algaroba trees have been planted out and these yield pasture for cattle and bees, from which a substantial revenue is being obtained. Two striking photographs are given, showing the character of the mountain slopes and the effect produced by the heavy rains in denuded places.

(4) In Kauai, H. LARSEN, Manager of the Kilauea Sugar Plantation Company, states that, of 64 kinds of trees being tested, eight have established themselves both in wet and drought conditions, and the list in order of merit is headed by *Albizzia Lebbek*, a well-known drought resisting leguminous tree of India.

It is seen that the task set themselves by the Hawaiian planters is no small one, but that it is being carried out with almost feverish energy.

C. A. B.

Note on the Evaluation of the Clerget Divisor in the Analysis of Sugar Mixtures.[1]

By RICHARD F. JACKSON and CLARA GILLIS SILSBEE.

In a recent article[2] entitled "The Analysis of Products containing Sucrose by the Neutral Double Polarization Method," C. L. HINTON has discussed two phases of the problem of the Clerget analysis with particular reference to the authors' modifications which have been previously described.[3] He has expressed himself as convinced that the salts which are added as a corrective to the direct polarization produce a constant effect upon the rotary power of sucrose, regardless of the concentration of the latter. He, however, criticizes unfavourably our methods of evaluating the Clerget divisor when invert sugar exists as an impurity in the sample taken for analysis, his contention being that the rotary power of invert sugar in the invert polarization is a function of the total invert sugar, regardless of its source, and therefore that the negative constituent of the Clerget divisor should correspond with the higher rotary power. He concludes that we overlooked this question in our original study of the problem.

That this point was not overlooked may be shown clearly by the following paragraphs[4] quoted from our original article :—

"An error in the prevailing methods of Clerget analysis which has hitherto apparently been overlooked is due to the fact that the specific rotation of invert sugar changes considerably with a change in concentration." A calculation then follows which shows that a pure invert sugar solution submitted to the Clerget analysis would indicate — 0·7 per cent. of sucrose. "Quite another question arises if the invert sugar is one constituent of a sucrose-invert sugar mixture. In such a case, even if total volumes of solution remain constant, the invert sugar is at a relatively low concentration in the direct polarization, and at relatively high concentration in the invert polarization when all the sucrose has become invert sugar." A single admittedly inadequate experiment is cited which shows that a "quantity of invert sugar . . . . produces about the same rotation in the presence of sucrose as it does if the sucrose is inverted and quite a different rotation if diluted with water. . . . On the other hand, we find that the value of the divisor must be corrected for concentration by the same amount that it would be in pure aqueous solution. Our conclusions in this respect must be considered empirical, since the problem of the rotation of mixtures is too large a one for a complete solution at this time. Obviously the experiment cited is inadequate in scope, and the question of this concentration effect must be considered an outstanding source of uncertainty. For the present we suggest that if the sample to be analysed contains invert sugar, both polarizations be made at the same concentration of total substance."

From the above quotation HINTON concludes that we assigned two different specific rotations to two portions of invert sugar existing in the same solution. Such is not the case. The fundamental principle of the Clerget analysis is that the *change* of polarization between direct and invert polarizations is a function of the sucrose. In other words, knowing little or nothing of the optical behaviour of each constituent of a complex sugar mixture, we disregard both the direct and invert polarizations individually and draw our conclusions solely from the *change* of polarization before and after inversion. This we have found empirically to be the same function of the sucrose in the presence of invert sugar as it is in water. The use of this principle is not peculiar to our methods, as HINTON implies, but is involved in all existing modifications of the Clerget method.

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[1] Published by permission of Director, Bureau of Standards. [2] *I.S.J.*, 1921, 689.

[3] *Bur. Standards Scientific Paper*, No. 375 ; *I.S.J.*, 1920, 509, 570, 638.

[4] *Bur. Standards Scientific Paper*, No. 375, p. 172 ; abridged in *I.S.J.*, 1920, 572.

Since the publication of our original paper an investigation on the rotation of of sugar mixtures has been published by W. C. VOSBURGH.[1] HINTON has cited from this article three points in its summary, namely, that the individual sugars in mixtures of dextrose and sucrose, and dextrose and levulose show the specific rotations which they would have in concentrations equal to the total sugar concentrations in the mixture, but that mixtures of sucrose and levulose deviate from this law. It is surprising that HINTON, having discussed these three points, should have failed to consider the fourth and fifth, which are the only ones pertinent to the present question.

The fourth conclusion which VOSBURGH draws from his experiments is that mixtures of sucrose and invert sugar deviate slightly from the law as stated above. This "slight" deviation amounts to 0·3 per cent. to 0·5 per cent. of the rotation of the mixture.[2] Furthermore, in his fifth conclusion he states that the deviation varies with the wave-length of the light source used for the measurement. VOSBURGH used the monochromatic light sources 5893 A, and 5461 A. What happens with the complex light source used in the saccharimeter would be difficult to conjecture.

It thus appears that the unusual mixture, sucrose and dextrose, is the only sucrose-containing mixture which conforms to the generalization. The latter does not apply with sufficient accuracy to mixtures of sucrose and invert sugar.

Applying these facts to the Clerget method for sucrose invert sugar mixtures, we reach the conclusion that the total change of polarization is the resultant of two factors : the change of polarization of the sucrose and the small change in specific rotation of the invert sugar. In the mixture, the rotation of the sucrose changes after inversion to a higher invert value than in pure water due to its higher concentration ; that of the invert sugar becomes slightly (see VOSBURGH) lower in the invert than in the direct polarization. If we knew exactly what the change in specific rotation of the invert sugar was, we could apply this as a correction to the P — P′ value and then evaluate the negative constituent of the divisor to correspond to the total concentration of invert sugar as HINTON suggests. It is, however, essential that if such a procedure were carried out both corrections be made with precision. To apply one and not the other, as HINTON has done, would lead to the gross errors which are to be expected to arise from faulty reasoning. HINTON has computed a table of divisors to be applied to the series of analyses previously published by the authors[3] in which he has assumed in spite of Vosburgh's statement to the contrary that the invert sugar retains a constant specific rotation throughout the analysis. In the light of the present discussion his calculations and all conclusions drawn from them must be disregarded.

Moreover, such a procedure as we have outlined would indeed be a futile one, for it could only be applied to solutions of exactly known composition. To apply it to unknown mixtures would require a complete qualitative and quantitative analysis before a Clerget test could be performed. What method, we may ask, would be employed when we deal with a mixture of sucrose, dextrose and levulose in varying proportions, and the array of non-sugars occurring in crude products? We therefore adhere to the statement in our original paper that the change of polarization of a sugar-invert-sugar mixture is the same function of the sucrose that it would be in pure aqueous solution of sucrose. This we found empirically to be true and have subsequently verified it in all analyses which we have performed.[1] Whether this is a purely accidental relation or is an evidence of some more fundamental principle, we cannot at present decide. By a curious solecism HINTON concludes that the very fidelity of our analytical results is evidence of incorrect methods.

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[1] *J. Amer. Chem. Soc.*, 1921, 43, 219 ; *I.S.J.*, 1921, 348.

[2] *Loc. cit.*, Table 1, page 223.

[3] *I.S.J.*, 1921, 445.

It is not intended to imply that future research will not make further contributions to the solution of the problems under discussion. In any case, the final criterion of correctness must be the experimental accuracy of analytical results and not speculative reasoning which is almost inevitably based on insufficient or doubtful premises. We therefore submit that the methods as given in our original paper are sound and have been shown to yield results of a high order of accuracy.

American Commerce Reports.[2]

THE FRENCH SUGAR INDUSTRY.

Of all French industries, sugar has perhaps been the most seriously affected by the war. Nearly all the usines were located in the region that suffered most severely as a result of hostilities, and of the 206 factories operating before the war 120 to 125 were destroyed. The refineries fared better. Of the 26 operating in 1913, only 13 were within possible striking distance of the enemy's guns, and six of these were either badly damaged or actually destroyed. At the same time, whereas the French refineries in 1912-13 handled 71 per cent. of the sugar consumed in France, in the 1919–20 and 1920–21 campaigns they handled only 55 per cent.

The usines date back, many of them, 60 or 70 years. The machinery used might be considered antiquated and the methods crude, but production costs have been kept down, and no other industry can show so many consecutive years of uninterrupted dividends on capital invested. In those now in process of restoration the tendency is to install improved modern machinery. This progress will eventually serve to lower production costs and will strengthen the position of the French sugar market in its relations with other countries.

Before the war native production of sugar was fairly adequate to meet the consuming needs of the country, except in certain years when, as in 1911, there was a partial failure of the beet-root crop. In 1913 the imports were about 90,000 tons less than the exports.

Official figures of the French production of sugar from the pre-war year 1913-14 up to the present time, the 1921–22 production being an estimate, are shown below:—

YEAR.	TONS.	YEAR.	TONS.
1913-14	717,000	1918-19	110,000
1914-15	302,960	1919-20	155,000
1915-16	135,900	1920-21	305,000
1916-17	185,435	1921-22	285,000
1917-18	200,265		

War conditions transformed France from a self-sustaining to an importing country. Imports of sugar rose to 521,000 tons in 1915, to 553,000 tons in 1916, and to 524,000 tons in 1917, the United States being the chief source of supply. The imports in post-war years, as compared with 1913, were as follows:—

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[1] *Bur. Standards Scientific Paper*, No. 375, page 190; *I.S.J.*, 1920, 643; 1921, 220, 448.

[2] Culled from "Commerce Reports," published by the Department of Commerce, Washington. In many cases these are abbreviated here.

SUGAR AND COUNTRIES OF ORIGIN.	1913. TONS.	1919. TONS.	1920. TONS.	1921. TONS.
RAW SUGAR:				
From French colonies	96,948	56,312	68,139	92,659
Guadeloupe	26,771	7,590	7,077	24,155
Martinique	36,621	5,793	23,807	22,486
Réunion	33,175	42,928	37,210	45,953
Other	381	1	45	65
From foreign countries	17,024	211,043	149,394	81,821
Cane sugar	17,024	210,979	147,086	64,269
Mauritius	—	2,169	10,727	4,888
Dutch East Indies	—	5,809	12,093	13,497
United States	—	42,946	15,832	14,756
Cuba	16,592	140,639	83,046	26,592
Peru	—	244	10,438	1,936
Dominican Republic	—	3,015	131	—
Other	432	16,157	14,819	2,600
Beet sugar	—	64	2,308	17,552
Belgium	—	64	—	16.523
Other	—	—	2,308	1,029
Total, raw sugar	113,972	267,355	217,533	174,480
REFINED SUGAR:				
Candy	765	772	961	523
Other	129	358,972	403,684	166,456
Netherlands	—	2,579	73	9,638
Belgium	3	7,066	7,758	16,110
Czecho-Slovakia	—	15,579	79,128	76,021
Mauritius	—	2,660	23,745	546
Dutch East Indies	—	10,810	21,084	4,608
United States	—	214,106	192,588	32,200
Brazil	—	2,681	7,578	332
Cuba	—	35,942	12,505	903
Other countries	126	67,549	59,225	26,098
Total, refined sugar	994	359,744	404,645	166,979
Sugar manufactured from waste	91	692	4,159	328
Grand total	115,057	627,791	626,337	341,787

By 1918 rationing restrictions had become so severe that consumption dropped to less than half of normal and imports to 178,000 tons. Native production continued to decline, the 1918-19 campaign yielding only 110,000 tons and that of 1919-20, 155,000 tons. With the relaxation of Government restrictions, however, consumption rapidly approached its normal volume. By 1919 the dependence of France on the New York market had become confirmed, and in 1920 three-fourths of the consumption supply was of foreign origin.

The annual French consumption of refined sugar from 1913 to 1920, with the estimate for 1921, is shown in the following table:—

YEAR.	TONS.	YEAR.	TONS.
1913	716,800	1918	303,000
1914	502,100	1919	643,300
1915	702,200	1920	713,000
1916	737,000	1921	600,000
1917	610,700		

American Commerce Reports.

Under the necessity of stimulating national production, the French customs duty on foreign sugar was raised in 1921 from 20 francs to 50 francs per 100 kilos (from $1·75 to $4·40 per 100 lbs. at normal exchange). With this protective duty, the French producer has nothing to fear from Cuban sugar so long as its f.o.b. price is over 2 cents. a lb. As Cuban sugar is bought through dollar exchange, a further protection is afforded by the low parity of francs in terms of the dollar.

SHIFTS IN EUROPEAN SUGAR TRADE.

Norway, Greece, Turkey, and Great Britain are the only European countries that do not produce considerable amounts of sugar. The total value of sugar imported into the United Kingdom in 1913 was more than £23,000,000 ($112,000,000 at normal exchange), which increased to £35,000,000 ($170,000,000) in 1921. In a single year before the war Germany sold 1,000,000 tons of beet sugar to British account. The temporary discontinuance of the German sugar export trade accounts for the shift to the West Indies as the principal source of British supply. England will remain for years the chief foreign market for American sugar. The unfavourable factors affecting American trade with England have to do with national policy. One of these is imperial preference, but there is a tendency to overestimate the influence of this on the British sugar market. Theoretically, British Guiana could be made to produce enough sugar to supply the British Isles, but, as a matter of fact, the production has not increased materially and the country remains an unimportant factor in the sugar trade.

The German beet sugar industry is rapidly recovering. Production for the present year is some 200,000 tons greater than last year, although the season has been unusually dry. Experts agree that the German output for the next season will probably increase by 500,000 tons.

Beet culture in the Netherlands and Belgium is increasing, with substantial gains in the production of raw sugar this year as over last season. Spain, France, Czecho-Slovakia are the only important producers that show a marked falling off in the year's crop. Spain is the only European country that grows both beet and cane sugar. Italy has swung over from the position of an importing to that of an exporting country. The surplus for exportation will remain small, however, for years to come.

Czecho-Slovakia and Poland are both interesting from the standpoint of exportation. The former is in a strong position with regard to exports, and, on account of financial disorganization, sugar forms a useful medium of exchange in foreign trade. A considerable amount of business has been done with France, with some contracts yet to run, based not upon firm prices but upon prices on the Paris market at the time of shipment. The country has also been paying off certain obligations to Switzerland in sugar. Trade opinion supports the view that Czecho-Slovakia's exportable surplus for the year is rapidly nearing exhaustion. At this time Cuba cane sugar is underselling Czech beet in the French market. Poland is far less favourably situated in respect to production. The country is really hardly more than self-sustaining as yet. In an effort, however, to find a medium of exchange, Poland has strained her sugar-exporting resources by way of barter for fertilizers, agricultural implements, and other necessities. [Department of Commerce Report from Paris, February, 1922].

DR. ALFRED LODE[1] calls attention to the fact that during the past campaign the high sugar content of beets in Germany has been remarkable, many factories averaging 2 per cent., and some roots having the astonishing richness of 27 per cent. These favourable results may of course have been largely assisted by the warm season and other climatic conditions, but all the same there can be no doubt that under the influence of selection the amount of sugar in the root has risen during the past few years. He believes that the limit of the accumulation of sugar in the beetroot has not yet been reached, and considers that recent researches justify him in predicting "with all probability" that by the application of certain new ideas on selection (which he does not divulge) the content will rise yet higher during the next few years.

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[1] *Blätter fur Zucker-Rübenbau*, 1922, No. 2.

Correspondence.

WHAT IS DEMERARA SUGAR ?

To the Editor, "The International Sugar Journal."

Sir,—Mr. Geoffrey Fairrie's campaign against "raw" direct consumption sugars, in the course of which he classes all sugars which have not passed through the refiner's hands as unfit for human consumption, brings forward again the question of "What is Demerara sugar?"

"Demerara" sugar—and this term does not mean all sugars coming from Demerara—is sugar made by an especial process, which requires the exercise of the greatest care and cleanliness in application, and which can only be successfully applied to juice of a certain description from certain canes grown under certain conditions. Indeed, so small is the field of successful manufacture, that Professor Sir John Harrison has described "Demerara" sugar as being a product of the Bourbon cane alone. It certainly originated with this cane, and its palmiest days were when this cane was cultivated in the West Indies.

To class modern 96° refining crystals with Demerara sugars of the right sort is on a par with confounding pig iron with highly tempered steel, or a fermented product which has to be distilled to render it potable, with a "Chateau" brand of claret.

Like other good things, the old-time Demerara sugar is gradually passing out of the sugar world. Its parent, the Bourbon cane, is practically defunct; the desire, fostered by science, to get more out of the cane, and the cane juice has led to conditions which render the manufacture of the old quality impossible, even if the raw material were suitable.

Attempts have been made of recent years to use an aniline dye to get back to the old Demerara sugar, the example of the refiner who dyes white sugar yellow to imitate it being followed; but this does not produce the real thing, and as in the case of mercerized cotton posing as silk, the fraud is exposed on washing.

The real fact of the matter is that the refiners of the United Kingdom are up against competition with direct consumption white plantation sugars—and they do not like it. Yet the only charge against these sugars which Mr. Fairrie makes is that although they look white, they are not.

I am, Sir, yours faithfully,

FREDERIC I. SCARD.

A Colonial Office report on Mauritius emphasizes that the only important crop grown in that island is sugar. There are 170,000 acres, about 35 per cent. of the total area of the colony, at present under cane cultivation, 2000 acres of which have been added during 1920. Of this acreage 55,000 is worked by the 54 factories, 38,000 are cultivated as estates of 100 acres or more without having a factory, and 76,000 acres are cultivated by personal proprietors, mostly Indians.

Decolorizing carbons are attracting attention in Germany, and at a recent meeting of chemists connected with the paper industry, Dr. Adler described the manufacture and advantages of the preparation recently patented by Knöpfelmacher,[1] which is made by neutralizing the waste liquor resulting from sulphate cellulose treatment with lime, evaporating to dryness, and heating to redness. In the discussion following, Dr. Block mentioned that there may be difficulty in completely removing "Carboraffin" (a particularly finely divided carbon) from the liquors to which it has been added, and that he was making experiments on the value of Plausen's[2] filter for this purpose. Probably, however, the best solution of this problem would be to make the decolorizing carbon in granular form, as animal charcoal.

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[1] *I.S.J.*, 1921, 111.

[2] *I.S.J.*, 1921, 680.

Publications Received.

Annual Reports on the Progress of Applied Chemistry. Vol. VI. (Society of Chemical Industry, Central House, London, E.C. 2.) 1922. Price: 7s. 6d. (post free to members of the Society; and 12s. 6d. to non-members).

These Annual Reports of the Progress of Allied Chemistry are now well known and well appreciated by chemists, and the volume dealing with 1921 has just been published. The section treating of "Sugars, Starches and Gums," has been contributed by Messrs. EYNON and LANE, Official Analysts to the Sugar Association of London, who give a very excellent account of the work done in every branch of our industry during the past year. There are likewise valuable summaries of the progress made in Agricultural Chemistry by Dr. E. J. RUSSELL, F.R.S., whose remarks on soil analysis in particular deserve the attention of all interested in this subject. Then there are good sections on the Fermentation Industries, Foods, and General Plant. As we have suggested on the occasion of the publication of previous volumes,[1] these Reports should be in the hands of every chemist, affording as they do a means of following the development of other branches of industry than that in which he has particularly specialized.

Regulations respecting the Manufacture or Importation of Alcohol for use as Motor Fuel. Statutory Rules and Orders, 1921, No. 1318. (H.M. Stationery Office, Imperial House, Kingsway, W. C. 2.) 1922. Price: 3d.

Alcohol imported from overseas for use as motor fuel must be denatured by a licensed methylator in the U.K. before it can be released for sale. These Rules and Orders lay down in considerable detail the regulations which must be conformed to in respect of the importation, removal, storage, sale, and use of the spirit. The following points in particular should be noted. All spirits used in the manufacture of power spirits shall have a strength before methylation not less than 66 per cent. O. P. (94·8 per cent. by volume); and the quantity shall not be less than 2500 gallons. In the denaturing operation the methylator shall mix with the spirit not less than 2½ per cent. (by volume) of wood naphtha, 0·5 per cent. of crude pyridine, and not less than 5 per cent. of benzol, and must add to every thousand gallons ¾ oz. of "Eosin (yellow shade)" dye and ¼ oz. of "Spirit Red 3" dye.

Interim Report of the Empire Motor Fuels Engineering Committee. W. R. Ormandy, F.I.C. (Imperial Motor Transport Council, 50, Pall Mall, London, S.W. 1.) 1922,

This Report summarizes the results of an investigation of the behaviour of alcohol in internal combustion engines, using alcohol of 95 per cent. by vol. It was found that all speeds with both high and low compression the thermal efficiency obtained with alcohol is higher than that obtainable with petrol or benzol at any compression which could be employed with them. Even at the low compression of 3·8 : 1, the thermal efficiency with alcohol is substantially greater than that obtained with petrol under similar conditions. In both cases the efficiency is almost independent of speed. The heat delivered to the circulating water is less in proportion with alcohol than with petrol. It was further found that compared to petrol or benzol the thermal efficiency obtained with alcohol is equally high at high or low compression. The tendency to pre-ignition began to be evident at 7 : 1 compression ratio. Owing to the lower heat value of alcohol, the fuel consumption is much higher than is the case with petrol, in spite of the higher thermal efficiency, if they are used at the same compression, but the fuel consumption can be reduced much further in the case of alcohol than in the case of petrol by increase of compression ratio. Experiments on the same lines were carried out with alcohol of 90 and also 99 per cent. by vol. strength, and the results obtained substantiate the other work, proving further that the mean effective pressure increases as the water content is increased so long as the whole of the fuel and water is completely evaporated before the end of the compression stroke.

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[1] *I.S.J.*, 1919, 34, 296; 1920, 342; 1921, 223.

Chemists and the Patent Laws. By Horatio Ballantyne, F.I.C. Lecture delivered before the Institute of Chemistry, London, February, 1922. (The Institute of Chemistry of Great Britain and Ireland, 30, Russell Square, London, W.C. 1.) 1922.

Mr. Ballantyne's highly instructive lecture dealt with the principles of chemical patenting, his several points being illustrated by examples of a number of cases; while not the least useful part of the address was some remarks on the Patents and Designs Act of 1919, which incorporates several important additions.[1] It is worth while quoting the opinion of this authority on the procedure of certain foreign patent offices: "The experiences of the patentee who proceeds to protect his invention in a number of industrial countries abroad are by no means always agreeable, and it is sometimes difficult to understand what principle underlies the objections raised by the examiners. I would here venture to give expression to an earnest appeal to the Dutch Patent Office in particular, in the hope that it may reach those in authority there, to bring their attitude towards the would-be patentee more into line with that of other enlightened countries. From various quarters in this and other countries, complaints are frequently heard of the difficulties, apparently unreasonable, which applicants encounter at The Hague. It is to be feared that the deterrent effect will in the long run operate to the disadvantage of Holland, since capital cannot be attracted to industries, and especially new industries, if inventors are unable to secure patent protection as readily as in other manufacturing communities. . . . . . ."

Colorimetric Analysis. By F. D. Snell. (D. van Nostrand Company, 8, Warren Street, New York, U.S.A.) 1921.

This is a useful small book in which the author has collected a number of colorimetric methods for the determination of important substances. For example, to select only a few of the tests, he gives particulars of the determination of iron using ferrocyanide, sulphocyanide, and sulphide; of copper using ammonia, ferrocyanide, and ethyl xanthate; of nitric acid using phenolsulphonic acid and pyrogallol and nitrous acid using sulphanilic acid and meta-phenylamine; and of salicylic acid using Fehling's solution. It is a most convenient work, and, seeing that it contains much information that has appeared in print only in the technical journals, it should be much appreciated by analysts as a means of ready reference to particulars relating to colorimetric methods, which are in use to a greater or less extent in most chemical laboratories. A word of criticism may be made; and this relates to the fact that only in a few cases is it possible to find any statement of the degree of accuracy of the tests described. It would be of great value to give some indication regarding this point, at any rate in respect of the more important colorimetric methods. We hope it may be possible to do this on the appearance of a future edition.

Micro-Organisms and some of their Industrial Uses. By A. Chaston Chapman, F.I.C., F.R.S. Cantor Lectures. (Royal Society of Arts, Adelphi, London, W.C. 2.) Price: 2s.

Contents: Mechanism of fermentation; nature of intermediate products; production of glycerin; use of moulds for saccharification of starch; amylo process; production of citric, pyruvic, fumaric, lactic, and butyric acids; bacterial production of acetone and butyl alcohol; utilization of waste distillery liquors; desirability of establishing a National Institute devoted to the study of industrial micro-biology.

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[1] *I.S.J.*, 1921, 709.

Brevities.

O. H. La Wall[1] points out that a 15–20 per cent. solution of commercial starch glucose forms an efficient anti-freezing mixture for automobile radiators, since it does not harden even at — 21°C. (— 6°F.), and has no corrosive action on metals or rubber piece connections.

In the course of his evidence before the Sugar Commission, which recently sat at Durban, Dr. H. A. Tempany, Director of Agriculture, Mauritius, expressed the opinion[2] that in a country such as Natal a sugar refinery is " an absolutely unnecessary excresence," adding that a direct consumption sugar should be produced in the factories themselves. It seemed to him a wasteful thing to make practically a direct consumption sugar, and then remelt the whole thing and refine it.

A patent has recently been taken out by G. G. Hepburn,[3] for the softening of water by filtration through a bed of peat, the reaction being said to be the fixation of the calcium and magnesium salts for the formation of insoluble compounds with the humic and ulmic acids When the softening power of the peat has become exhausted, it may be regenerated by treatment with a hot dilute solution of common salt, sodium carbonate, or caustic soda. This process, therefore, is somewhat similar in principle to the well-known "Permutit" method.

In an anonymous article[4] a German writer compares the composition of American and German table syrups made from beets, giving the following average figures for the two kinds in the order mentioned: Brix, 70·29, 80·11; sucrose, 63·20, 23·88; invert sugar, 2·73, 40·26; undetermined, 3·00, 15·97; ash, 1·37, 2·11; and purity, 93·6, 88·5. He remarks that while the Brix of the American is held at about 70° in order to prevent crystallization, the German syrup can be concentrated to about 80° Brix, owing to the higher proportion of invert sugar present.[5] " The taste and smell of the German syrup are indeed not to everyone's liking, but it forms a material for spreading on bread which is readily consumed by many children and adults."

An effective reply (headed "Fairrie Tales") is made in the *West India Committee Circular*[6] to the misstatements recently made regarding direct consumption sugars, from which the following extract is taken: "Mr. Geoffrey Fairrie now stated on the authority of 'one of the most eminent authorities in the country' that a 'muddy sediment' appeared when these sugars were dissolved in water, and that it contained sugar-cane fragments, amorphous matter, miscellaneous debris, bacteria, fragments of living mould, mould spores and dead yeast cells. . . . . . Now it is, to say the least of it, a curious coincidence that in his earlier lecture[7] Mr. Fairrie should have given almost word for word a statement made in an anonymous pamphlet entitled 'Report on Direct Consumption Sugar' published in 1917, regarding raw sugar being made by 'natives whose habits are not altogether objectionable' and that in his latest utterance his list of horrors should be an almost exact paraphrase of one given by the anonymous author of that pamphlet. In the circumstances it would not be unfair to assume that Mr. Fairrie's 'eminent authority' was the anonymous compiler of the pamphlet. Granted that it would not be, the whole basis of Mr. Fairrie's argument falls to the ground, for the sugar reported upon by the anonymous pamphleteer included sugar from Cuba, which does not produce either West India crystallized or genuine muscovado or other direct consumption sugar; and the pamphleteer added that samples were *taken at a well-known refinery.* So the cat is out of the bag, and it would appear that thus Mr. Fairrie is attributing to direct consumption sugars attributes of refining sugar analysed by an anonymous authority who published an anonymous pamphlet in 1917! Mr. Fairrie would do better to attend to the business of developing the refining capacity of this country than to casting muddy sediments against imported sugars whose excellence is a household word."

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[1] *Amer. Jl. Pharm.*, 1933, **94**, 97–98

[2] *South African Sugar Journal*, 1922, **6**, No. 3, 167,

[3] U. K. Patent, 173,255.

[4] *Centr. Zuckerind.*, 1921, **30**, No. 10, 243.

[5] In order to prevent graining, the proportions which are found satisfactory are 40 per cent. invert sugar, and 30 per cent. of sucrose.—Ed., *I.S.J.*

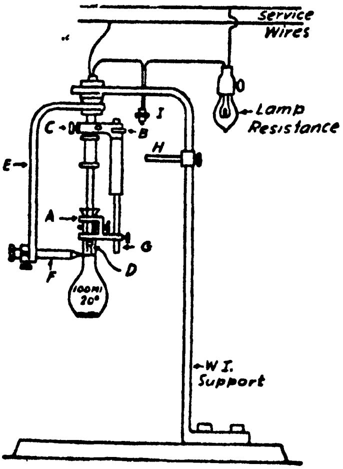
[6] 1922, **37**, No. 616, 217.

[7] *I.S.J.*, 1922, 78.

Review of Current Technical Literature.[1]

CALIBRATION OF FLASKS, AS CARRIED OUT BY THE CUBAN-AMERICAN SUGAR CO. *Guilford L. Spencer. Journal of Industrial and Engineering Chemistry, 1921, 13, No. 11, 1058-1059.*

This device was originally intended only for marking precision flasks, but it may be used in combination with a calibrating burette in judging the accuracy of the marking of such flasks, since it locates the position of the meniscus with greater accuracy than is possible by the eye with customary aids. It is a means of bringing a pair of electrodes into contact with acidulated water at the centre of the meniscus, in the neck of the flask, indicating the point of contact, and marking the neck with a ring at this level. The electrodes are connected in a series with an incandescent lamp and the service wires. I desired, a cell containing dilute sulphuric acid, into which dip platinum wires, also in series with the lamp, may be used in addition to the signal (described later) for indicating the contact of the electrodes with the liquid in the flask. A galvanometer could be used for this purpurpose, but these devices have not been found necessary. The audible and visual signals of the contact of the electrodes at the meniscus are clear and within the accuracy of the calibrating burette and the practical applications of the flasks. The liquid used in calibrating is distilled water, containing about 1 c.c. of sulphuric acid per litre. The usual precautions of expelling the air from the dilute acid and avoiding vibration and temperature fluctuations are observed. The neck of the flask is varnished or waxed in a wide band at the probable location of the mark; the flask is clamped in its holder; and the desired volume of acidulated water is measured into it with the calibrating burette. The holder is next slipped over the micrometer post, with the guide pin in the groove, and the flask is raised nearly to contact of the electrodes with the liquid; and the holder is clamped to the post and is centered by means of the three screws. Previous to placing a flask in the apparatus, the graving needle is so adjusted that its point falls at the bottom of the central electrode and it is then withdrawn A lock nut is provided for making this adjustment, which is semi-permanent.



A, flask clamp; *B*, micrometer head and post; *C*, flask centering screws; *D*, platinum electrodes; *E*, sweep; *F*, graving tool; *G*, lower end of micrometer post; *H*, adjustable plate for hand rest; and *I*, the switch.

Having centered the flask, the switch is closed, and the micrometer head is turned little by little, lifting the flask until the central electrode, which is slightly higher than the other, touches the liquid. At the instant of contact, there is a distinct sound made by the evolution of gases, and this or the appearance of gas shows that the contact has been made. The wattage of the incandescent lamp determines the distinctness of the signal. The switch is now opened. Experience has shown that with rapid work, and before the gas and heat evolved appreciably affect the liquid, three or four contact points can be located within the limits of accuracy of the calibrating burette, and guided by the noise only, or in other words, with the operator blindfolded. The graver is now pushed till nearly in contact with the neck of the flask and then, by means of the fine adjusting screw, to full contact. A spring and follower press against the graving needle. The spring and follower in the graver-holder, bearing on the graver, provide against the effects of slight distortion of the neck, or failure to exactly centre the flask. The sweep is revolved and the graver cuts a ring in the varnish or wax, and the glass is ready for etching.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*

The micrometer may be made with standard taps and dies (S.A.E.) 24 threads per in. This corresponds nearly to 1·058 mm. pitch or vertical travel of the post per complete revolution of the head. Since the micrometer head is sensitive to less than one-twentieth revolution, the instrument is sensitive to less than 0·0529 mm. vertical travel of the post. Assuming the marking of a Bates' 100-c.c. flask of 12 mm. internal neck diameter: Area = 113·1 sq. mm. and 113·1 × 0·0529 = 5·98 cub. mm. or 0·006 c.c. It is possible to graduate a lighter flask of 20 mm. internal neck diameter to 0·02 c.c., which is well within the limits of the accuracy of the calibrating burette.

TIME WHICH MAY BE ALLOTTED TO THE VARIOUS LABORATORY DETERMINATIONS USED IN THE CHEMICAL CONTROL OF THE FACTORY. Anon. *Tydschrift, 1922, No. 8, 137-140.*

At the end of the last campaign of the "Holland" beet factory, the assistants were made to engage in a competition for the purpose of ascertaining the time necessary for carrying out the various analyses in the shortest possible period commensurate with the necessary degree of accuracy; and from these observations it was possible to compile the following estimate covering most of the determinations required in chemical control, the co-operation of two chemists being assumed, and the calculation of the results being included in each case:—Sucrose in slices (in duplicate), 7 mins. 32 secs.; sucrose in beet pulp (from two batteries) by hot digestion, 7 mins. 32 secs.; Brix, polarization, alkalinity of thick-juice, 17 mins. 27 secs.; colour of thick-juice, 5 mins.; sulphur dioxide content of thick-juice, 5 mins.; Brix, polarization, alkalinity of massecuite or first molasses, 20-25 mins.; polarization and ash of raw sugar, 37 mins.; Brix and polarization of final molasses, 15 mins.; and ash of final molasses, 30 mins.

IMPROVEMENTS IN THE CONSTRUCTION OF ABBE REFRACTOMETERS. Carl Zeiss. *United Kingdom Patents, 172,621 and 172,622.*[1]

MEASUREMENT OF THE TEMPERATURE OF SUGAR AFTER CENTRIFUGING. A. Kraisy. *Vereinszeitschrift, 1922, 159-162.*

It is sometimes of importance to be able to state the temperature of the white sugar in the centrifugals after swinging, since on the heat retained by the crystals depends largely the readiness with which the moisture remaining may be eliminated, whether, in fact, a dry product which will store well can be obtained. This temperature is controlled by the original temperature of the massecuite entering the machines, and by the amount and temperature of the covering with which the sugar has been washed; but its determination by simply sticking a thermometer into the sugar is impracticable, owing to the low heat conductivity of this product. Reliable results are found in the following way: A wide-necked Dewar's vacuum vessel (a "Thermos" flask serves well) holding about half-a-litre is fitted with a thermometer by means of a well-fitted cork, the bulb of the instrument reaching to the low part of the interior. The temperature (t^1) is read; then 200 grms. of the sugar under examination is introduced while holding the flask sideways so that the thermometer may be conveniently replaced. After carefully shaking in order to mix the contents of the flask and allow the temperature equilibrium between thermometer, sugar, and the walls of the flask to take place, a second reading (t^2) is made, about three minutes sufficing for the level of the mercury to become constant. Then the temperature of the sugar (t^x) is calculated from the equation:

$$t_x = t^2 + \frac{W}{0{\cdot}3\,G}(t^2 - t^1),$$

in which W is the water equivalent (established by a preliminary experiment using of course the same apparatus); G, the weight of sugar introduced in grms.; and 0·3, the specific heat of the sugar. In order to examine the accuracy of the method; granulated sugar which had been heated for four hours to about 80° C. in an oven was submitted to the test and results agreeing within 0·7° C. were obtained.

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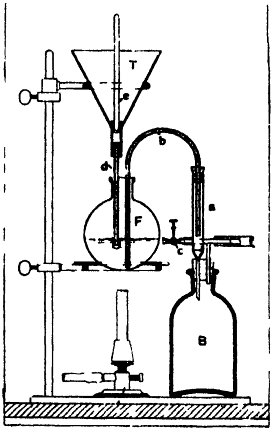
[1] See *I.S.J.*, 1922, 274.

Appreciation of Joseph Priestley. *C. A. Browne. Journal of Industrial and Engineering Chemistry, 1921, 13, No. 10, 879.*

On the occasion of the presentation by Dr. E. F. Smith of a reproduction of the famous Stuart painting of Priestley, Dr. Browne delivered a remarkably interesting lecture on "the discoverer of oxygen, ammonia, hydrogen chloride, sulphur dioxide, nitrous oxide and various other gases—the greatest pioneer, so to speak, in that branch of our science known as pneumatic chemistry," who also achieved great distinction as a theologian, a philosopher, a sociologist and an educationalist. Religious and political persecutions forced him to leave England and find an asylum in America, which led Dr. Browne to remark that "he is one of those common possessions, which, belonging to England and America alike, work for unity of thought and feeling."

Apparatus for use in the Determination of Reducing Sugars by the Volumetric Permanganate Method. *J. van der Haar. Archief, 1922, 30, No. 13, 213 216.*

There is no doubt that the permanganate volumetric method[1] gives very good results; though, according to this writer, the transference of the precipitate of Cu_2O to the filter-tube requires a fair amount of skill and attention. Therefore, with the purpose of further simplifying the method, he has devised the apparatus shown in the illustration, which in the main consists of three essential parts: (1) a round boiling flask *F* of 500 c c. capacity, resting on an asbestos sheet having an opening 6 cm. in diam.; and (2) a bottle *B* of 1 litre capacity, the diameter of the neck of which is the same as that of the flask *F*. As is clearly depicted in the drawing, the bottle *B* is provided with a rubber 2-holed stopper, one hole taking the Soxhlet filter-tube *a*, and the other a T-piece connected to a vacuum-pump and also to a piece of rubber tube closed by means of a clip. The Soxhlet tube *a* is connected to the flask by means of a bent piece of glass tubing *b*, 2 mm. in internal diam. one end of which reaches to within 1 mm. of the layer of asbestos in the filter-tube, and the other almost to the bottom of the boiling flask *F*, all as is clearly shown. Then the third essential part is the funnel *T* having a diam. of 12 cm., into the stem of which is fixed a piece of straight glass tubing *d*, 2 mm. in internal diam., on the end of which is packed by means of a couple of pieces of sewing thread a little glass cap; while the neck of the funnel is closed by means of a rubber stopper fixed to the end of a piece of solid glass tubing *e*, the funnel being supported by a ring clamped to a retort stand. In using the apparatus, the funnel *T*, the straight tube *d*, and the bent tube *b*, are first removed from the round flask *F*, while the Soxhlet tube *a* is filled with distilled water. Into the round flask *F* (which has previously been boiled out successively with 40 per cent. sodium hydroxide, nitric acid, and water) 50 c.c. of Fehling's solution, and 50 c.c. of the solution of sugar under examination are placed, the mixture boiled for 2 mins. in the prescribed manner, and cooled by the addition of 100 c.c. of distilled water, after which the funnel *T* and the straight tube *d* are placed in position, as shown in the drawing. The precipitate of Cu_2O is allowed to settle out; the funnel filled with boiling water; and the position of the end of the straight tube *d* so adjusted once and for all that the top of the little cap is just at the level of the liquid in the round flask. After removing the stopper *e* from the neck of the funnel, suction is commenced, and is so regulated by means of the clip *c* that the level of the liquid in the round flask remains constant. The funnel is removed, and the remainder of the liquid in the round flask sucked over, leaving the precipitate still standing under water. Now the rubber stopper of the bottle *B* with its filter-tube and T-piece are



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[1] *I.S.J.*, 1915, 236; 1919. 354; 1920, 413.

transferred to the neck of the round flask *F*; a small amount of a measured volume of ferrous ammonium sulphate is drawn through the bent tube *b* to dissolve any Cu_2O that may be present in it, this tube being afterwards washed and removed; while the rest of the ferrous ammonium sulphate is passed through the filter-tube, and the asbestos washed with hot water. Lastly, the contents of the round flask are acidified with dilute sulphuric acid, and titrated with the standard permanganate.

UTILIZATION OF BAGASSE FOR THE MANUFACTURE OF MILL BOARD ("CELOTEX") IN LOUISIANA.[1] **R. Renton Hind.** *Sugar News, 1922, 3, No. 2, 64-72.*

Last August, a factory costing about $500,000 was started in Louisiana for the manufacture of mill board using bagasse, the patented process under which this material (which is called "Celotex") is manufactured being in brief as follows: After cooking to destroy the bacteria which during subsequent operations cause decomposition, the bagasse is treated with chemicals the purpose of which is to render the finished material waterproof. The pulp is treated in beaters such as are used in wood-pulp paper factories, and rolled into sheets of varying thickness, 12 ft. wide × 90 ft. long, which are transferred to drying sheds, and when dry are cut into suitable sizes for commercial use, say 4 ft. × 12 ft. Mill boarding thus manufactured is light, the ½ in. thickness weighing only ½ lb. per sq. ft.; while one ton of bagasse suffices to make 3000 sq. ft. of the ½ in. thickness. It is moreover, quite waterproof, a board submerged in water for 20 days absorbing only 0·1 per cent. of moisture by weight. In districts where bagasse is available, and where there is a demand locally for cheap building material, the possibilities for the manufacture of this bagasse mill board are promising. Few factories, however, have an excess of bagasse for disposal, and if extra fuel must be used to maintain steam while utilizing the bagasse for this purpose, the question must be studied carefully in all its economic aspects before embarking upon the new venture.

USE OF INJECTION CONDENSERS INSTEAD OF TUBULAR RE-HEATERS FOR RAISING THE TEMPERATURE OF JUICE IN THE BEET SUGAR FACTORY. (1) **Friedbert Brukner.** *Die deutsche Zuckerindustrie, 1921, 46, No. 51, 739-740.* (2) **E. Saillard.** *Suppl. à la Circ. hebd. d. Syndic. d. Fabr. de Sucre de France, Nos. 1712* and *1713.* (3) **H. Claassen.** *Centralblatt für die Zuckerindustrie, 1921, 30, No. 14, 355.*

(1) In order to raise the temperature of the juice before carbonatation to about 85° C., the writer during the last campaign installed an injection condenser fed by vapour as 90° C. taken from the second vessel of the multiple effect evaporator, in which apparatus the liquid trickled over perforated trays, and thus came well in contact with the heating medium. In the ordinary way, the juice would have been heated in a multiple tube apparatus with steam from the Pauly pre-evaporator; but it is claimed when following the method now proposed of using second-vessel vapour that the consumption of live steam required for feeding the Pauly remains unchanged. In calculating the amount of second-vessel vapour necessary, say in the case of 1 million centners of roots, that is 50 million kg., it is assumed that the amount of juice to be heated is 50 million × 1·15 kg., the specific heat of the liquid is 0·9, and the increase of temperature is 60 to 85° C., so that 50 million × 1·15 × 0·9 × 25 = 1300 million calories, corresponding to 1300/550 = 2,363,636 kg. of second-vessel vapour of 90° C. (2) Commenting upon this suggestion of the German writer, Mr. SAILLARD remarks that its advantage is that instead of juice-heaters the cheaper installation of the injection condenser may be employed. Its disadvantage, however, is that the steam consumption in the evaporator proper is increased, since then there is also the water to be evaporated which has become condensed in the juice during process of heating by the second-vessel vapour. Consequently, the heating surface of the evaporator must be greater, though the amount by which it must be enlarged is really proportionately less than the heating surface of the juice-heaters, as the result of the difference in the

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[1] *I.S.J.*, 1921, 641.

co-efficient of transmission in the two methods. Still, there are some factories in which the heating surface of the evaporating plant is already greater than is necessary, and in such cases the proposed method of heating might very well be applied. (3) Dr. CLAASSEN recalls that the same proposal for directly heating the juice by vapour was made about 28 years ago by MELICHAR,[1] though he does not appear to have put his idea into practice, probably being deterred by Jelinek's warning that the process would prove uneconomical on account of the necessity of evaporating the vapour condensed during heating in this way. Under the conditions prevailing at that time, this objection was founded; but now that vapour can be withdrawn at 80-90° C., that is vapour which is 3 or 4 steps removed from boiler steam, one may regard the proposed procedure as probably economical in spite of the necessity of evaporating the condensed water. Therefore, Brukner's proposal should be put to the test for the purpose of evolving a practical apparatus which will not only heat the juice almost to the same temperature as the steam used, but also will obviate all loss due to the formation of froth while so doing.

SPACING OF THE PLANTS IN SUGAR BEET CULTIVATION. *A. Herzfeld. Vereinszeitschrift, 1922, 141-159.*

It has been decided in Germany to carry out a series of experiments for the purpose of establishing the optimum spacing of the plants in sugar beet cultivation ; and a sub-committee of the Landwirtschafts-gesellschaft für Zuckerrübenbau has sat in order to draw up a plan of work. In brief, in these experiments, rows which are 40, 50 and 60 cm. (16, 20 and 24 in.) apart shall be set out, and the distance of the plants in each trial shall be about 25 cm. (10 in.). Three plots shall be cultivated, the size of which shall not be less than 500 sq. m. (5400 sq. ft.) nor more than 1250 sq. m. (13,500 sq. ft.) ; while Klein-wanzleben seed Mark N shall be sown. In due course the results obtained will be published. During the proceedings of the sub-committee, the necessity of collating the literature of the subject was frequently expressed, and this Prof. HERZFELD has now done with the assistance of the librarian of the Institut für Zuckerindustrie, commencing as far back as 1856 and finishing right up to date.

PURIFICATION OF BEET SYRUPS AND MOLASSES BY MEANS OF SIMULTANEOUS CARBONATATION. *Karl Urban. Zeitsch. Zuckerind. cechoslovak. Republik, 1922, 45 (iii), 323-331, 344-351.*

CLAASSEN[2] and SCHNELL[3] have stated that when beet molasses is limed and carbonated, and perhaps also sulphited, no increase in the purity can be detected ; while there are others who, though admitting this, state the product is improved physically by this treatment, that is, its viscosity is lowered, so that it is much more readily boiled to grain. In this paper a large number of experiments are described demonstrating that by means of a process (patented by the author) a large increase in the purity, as well as a considerable diminution of colour and ash, can be realized, though it may be remarked a large amount of lime must be used in order to obtain a particularly good effect. In some of the preliminary experiments, the lime was added to the diluted molasses in one dose, carbon dioxide being next passed in to neutrality ; in others the lime was added in a number of different portions ; while later it was found that in order to secure the best results in respect of purity it was necessary to add the lime in small amount only, so that, for example, the alkalinity never exceeded 0·2 to 0·3 per cent. CaO, saturation with CO_2 to neutrality following each addition. Ultimately a process of simultaneous liming and carbonating was evolved, the details of which are as follows : Syrup or molasses at a concentration of 50-60° Brix is heated to 90°C., and milk-of-lime, or a mixture of milk-of-lime and molasses added, while CO_2 is passed into the liquid at the same time, the alkalinity being held as low throughout the operation, say within 0·01 and 0·10 per cent. CaO per 100 c.c. In an experiment carried out on the large scale, using 12·5 per cent. of lime of the weight of molasses, and keeping the alkalinity between 0·05 and 0·10 per cent., an increase in the purity of 3·7°, a decrease in the colour of 64 per cent., and a decrease in the ash content of 9·7 and of the lime content of 41·3 per cent., was realized. Rather large amounts of lime were necessary to obtain much better results.

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[1] *Zeitsch. Zuckerind. Böhm.*, 1894–95, 207.

[2] "Die Zuckerfabrikation"; 1918 edition, page 268. [3] *Centralblatt*, 1903, 755.

USE OF LIME CONTAINING MAGNESIA (DOLOMITIC LIME) FOR THE CARBONATATION OF SYRUPS, MOLASSES, AND LIQUORS OF THE FACTORY AND REFINERY. *K. Andrlik and W. Kohn. Listy cukrovarnické, 1921-22, No. 24, 243; Zeitsch. Zuckerind. cechoslov. Republik, 1922, 45, (iii), No. 28, 311-313.*

Following up their previous work on the use of lime containing a comparatively high amount of magnesia for the carbonatation of beet juices,[1] the authors now consider the carbonatation of factory and refinery syrups and the like. In the laboratory experiments which they carried out, the limestone used contained 25·22 per cent. of CaO and 8·01 per cent. of MgO. Green syrup from a raw sugar factory, for example, was diluted to about 22° Brix, treated with 5 per cent. by volume of a milk of 18° Bé. made from the lime mentioned, saturated with CO_2 to an alkalinity of 0·10 per cent., and filtered through cloth, after which without the addition of more milk-of-lime a second carbonatation followed to 0·017 per cent. It was then found that the purity had increased by 0·6°, and the colour had decreased by 65 per cent. Working in much the same way, somewhat similar results were obtained with the first molasses resulting from the affining of raw beet sugar; while with a liquor made by melting raw beet sugar the increase in purity was 0·84°, and the decrease in colour no less than 82 6 per cent. These satisfactory results make it desirable to test the use of this dolomitic lime in large-scale practice, and this the authors intend to do.

DETERMINATION OF THE SUCROSE LOST IN THE CARBONATATION SCUMS OF THE BEET FACTORY. *H. Claassen. Centr. Zuckerind, 1922, 30, No. 26, 703.*

Generally at the present time the total amount of carbonatation scum is found by establishing the average weight of that discharged per press, and multiplying this figure (which is verified from time to time) by the number of presses in use; while the sugar is determined in an average sample taken from a number of cakes by means of a trier. Hitherto, there appears to have been little doubt regarding the sufficient accuracy of this procedure for ascertaining the loss of sugar at this stage of manufacture; but some results obtained by Dr. CLAASSEN at Dormagen gave one a different impression. In factories in which the press scums are not dried, but are washed into a screw conveyor and pumped away, the loss of sugar may be determined by carefully taking an average sample from the mixing tank placed before the pump, and calculating the weight from its volume and density,[2] the sucrose being found in a portion in the usual manner. Both methods have been employed concurrently for many years past at Dormagen, but the latter shows an average figure which is 1·5 to 3·0 times higher than the older one. VASSEUX in his paper on the new apparatus used in the Oxnard beet factory, Cal.,[3] publishes a similar result, and the cause of this difference seems sufficiently important to form the subject of an investigation by the Institut für Zuckerindustrie, Berlin. According to the view of Dr. CLAASSEN, there is no doubt that the results given by the new method are the more correct (which also seems to be the view of the American chemists); and in his opinion, owing to the greater accuracy of the sampling which it permits, this method of working with the scum milk should be adopted, where possible, in preference to the other.

J. P. O.

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[1] *I.S J.*, 1922, 270.

[2] A table is here given showing: (*a*) specific gravity, and (*b*) solid scum content for mixtures from 8 to 40 per cent.

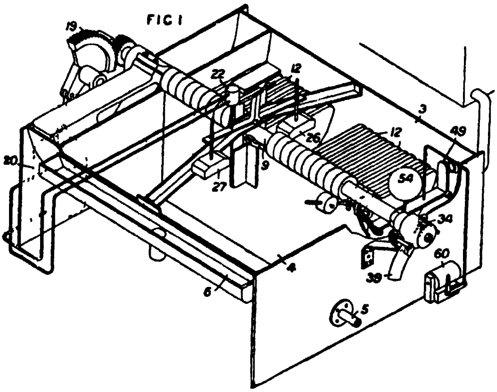
[3] *Bull. Assoc. Chim. Sucr. Dist.*, 1921, 39, 34.

Review of Recent Patents.[1]

UNITED KINGDOM.

VACUUM FILTERING APPARATUS. *Wilhelm Mauss*, of Johannesburg, Union of South Africa. *176,395.* August 18th, 1920.

In the operation of a vacuum filter, especially when treating liquid such as sugar juice containing colloids having a considerable influence on the filter medium, the capacity of the apparatus progressively diminishes until conditions are reached when it is no longer economical to operate, at which point the filter medium must be cleaned. This invention consists in a vacuum leaf filter which automatically stops the filtering operation when the capacity has fallen to a predetermined degree, the filter leaves being then removed from the liquid for cleansing. As may be seen in the drawing, a series of leaves *12* is supported by a hollow shaft *9* which oscillates in bearings on a tank having a filtering-compartment *3* and a cleansing compartment *4*. Liquid to be filtered is supplied to the compartment *3* through a valve *49* controlled by a float *54*, so that the supply is gradually cut off as the leaves become clogged. When cleansing is necessary, a float *26* operates a valve *22* which controls the distribution of actuating-fluid to a motor *20*. The motor oscillates the shaft *9* by means of a quadrant *19*. Liquid from the interior of the leaves is drawn by a vacuum through the hollow shaft, a plug valve *34* at one end and a flexible hose *39*. Oscillation of the shaft to lift the leaves from the compartment *3* to the compartment *4* closes the valve *34* and opens a similar one at the other end of the shaft to admit steam to the interior of the leaves. Wash water is supplied to the compartment *4* through a pipe *5*, and on immersion of the leaves the liquid level rises, overflow takes place to a trough *6*, and a float *27* is lifted to reverse the valve *22* and the operation of the motor *20* A trip device keeps the valve *49* closed while the leaves are out of the compartment *3*. The valve *34* is so constructed that suction is maintained on the leaves for a greater portion of the movement from the compartment *3* to the compartment *4* than of the reverse movement. A clock-driven drum *60* is used to record the movements of the valve *49*. A glass inspection section is included in the connexion between each leaf and the hollow shaft.



ROTARY DISC FILTER. *Hans Jung*, of Berlin-Lichterfelde, Germany. *176,495.* December 7th, 1920.

An apparatus for filtering sugar, dyes, etc., comprises a series of discs, the hubs of which have apertures forming, when the discs are placed together on a shaft, continuous passages through some of which filtered liquid is discharged from discs and through others fluid is supplied to the alternate discs for treatment of the separated solid matter. The discs may be of clay, fire-brick, or kieselguhr, or covered with filter cloth; they are provided with inner channels or passages and divided into sectors communicating with separate passages.

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[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2fr. 00 each).

Dumb Turners for Mills. *William Mackie and A. & W. Smith & Co., Ltd.,* of 120, Dale Street, S.S., Glasgow. *176,717.* May 28th, 1921.

This invention has as its object to improve the construction and action of the adjusting devices of dumb turners, so that whilst the wedge bolts may be readily adjustable either from above or beneath the rolls, as usual, an efficient and rigid support for the dumb turner and its carrying bar is afforded without it being necessary to accurately machine the co-acting wedge faces to exactly the same angle. The device comprises essentially cylindrical projections on the opposite ends of the dumb turner bar, a bearing block journalled on each projection, the blocks being made in halves with a space between their adjacent faces, so that both portions are free to swivel on their journal projection independently of each other, snugs on the housings between which the bearing blocks extend, an inclined wedge face on the inner side of each snug, or on the outer side of each split-bearing block, or on both, counterpart wedges between each snug and the outer sides of each block, and lastly, means for adjusting the position of the wedges. Turning to the illustration, it is seen that the dumb turner *A* is carried on the upper side of a rocking bar A^1 which is formed with cylindrical projections A^2 at each end. Rectangular bearing blocks *B*, made in halves and with a space B^1 between them, embrace each projection, being held in position by wedges C^1, C^2. The wedges are adjustable by means of sleeves D^1 on bolts *D* passing through the wedges and pivoted at the lower ends to the housing. The other faces of the wedges bear upon blocks B^2, B^3. In a modification, wedge faces are formed on the bearing blocks *B* and the faces of the parts B^2, B^3 are vertical In another form the wedge faces are on the bearing blocks, or all the parts *B*, C^1, C^2 may be wedge-shaped. Adjustment may be made from below.

FIG I

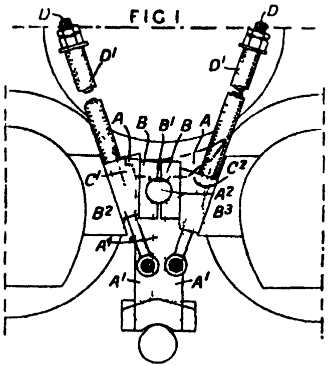
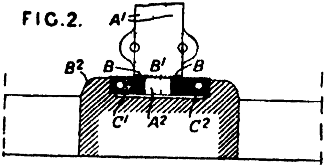


FIG.2.



Regeneration of Decolorizing Carbon by Treatment with Acid. *Johan N. A. Sauer,* den Texstraat 2, Amsterdam, Holland. *177,180.* June 20th, 1922.

After being washed free from sugar, the exhausted decolorizing carbon is boiled for a prolonged time (one hour or longer) in a wooden vat provided with stirrers, using, for example, a 2 per cent. aqueous solution of hydrochloric acid, or an equivalent amount of suitable acid, other than sulphuric acid. According to the degree of exhaustion of the carbon, more or less acid must be used. After this treatment, the paste may be diluted with a large amount of water (preferably hot) to reduce the acidity, and may then be pumped say into a filter-press, or other suitable separating apparatus may be used. It is then washed with hot water until practically all the soluble substances are removed, and may lastly be employed as it is, or dried in any suitable way before being again used.

Carbon thus regenerated may be used once or a number of times for the purification of juices or liquors ; and when its action is no longer satisfactory, it may again be subjected to the acid treatment just described. This may be repeated several times until the results obtained are below expectation. When this condition is reached, that is when the acid treatment alone is no longer sufficient to restore the carbon to a serviceable condition, there is employed a 2-stage regenerating treatment, one stage consisting of an exclusive acid treatment as described above, and the other of a reburning operation performed in any approved manner. This reburning stage may follow or may precede the acid treatment, but sometimes preferably it should precede, since reburning will convert certain organic acid compounds into calcium carbonate, which by the acid treatment can be washed out readily. Occasionally, after employing the 2-step regenerating operation, consisting of an acid treatment followed by reburning, the addition of a 3rd step consisting of another acid treatment as described, is of advantage, especially if the carbon is much contaminated.

The inventor points out in his specification that hydrochloric acid has been proposed for use for the neutralization of alkalis with which the carbon has been boiled for its regeneration; but states that the manner and purpose of using the hydrochloric acid are quite different from the present case. "For this purpose only, viz. for neutralization after the regeneration with alkalies, acid was suggested in these earlier processes." It has also been suggested to use weak hydrochloric acid solutions to remove say an excess of calcium carbonate from spent animal charcoal; but this treatment will not enable spent char to be used again without a special regeneration process, reburning being commonly used in this case.

Centrifugal Filter. *Robert A. Sturgeon,* of Central Ironworks, Huddersfield. *175,478.* December 13th, 1920.

A machine in which centrifugal separation is combined with filter-pressing is described, during the running of which the pressure which produces the filter-press action is obtained by the centrifugal head of the feeding column of liquid. It consists in the combination with an outer bowl or cylinder of greater diameter than the actual liquid inlet into the machine, one of the bowls being provided with a filtering medium, the inner bowl being spaced from the outer one to give a centrifugalizing space, the two bowls being so disposed in relation to each other that the pressure head induced in the liquid by centrifugal force will impel the separated liquid through the filtering medium and when separated solids fill the space will press them against the filtering medium to expel the contained liquid through the filtering medium.

Crystallizer for Massecuite. *Lingi Venditti,* of the Zuccherificio di Valsacco, Italy. *175,680.* October 15th, 1920. (Three figures; seven claims.)

Massecuite is caused to crystallize by being passed downwards through a series of cooling tanks, which are arranged step-wise, and are separated by intermediate mixing tanks. Water (or other suitable cooling agent) is passed through coils in the cooling tanks in the reverse direction to the massecuite; while residual syrup from a previous operation may be added to the massecuite in the intermediate mixing tanks for the purpose of correcting the density when necessary. Both cooling and mixing tanks are provided with suitable stirrers; and the said cooling tanks have communication between each other and through the mixing tanks in such a way that the massecuite moves through all of them by passing successively from one to the other. There may be no difference of height between the several cooling tanks, in which case mechanical means, such as a pump, are used for furthering the passage of the massecuite from one tank to the next.[1]

Anti-Rust Composition. *J. Beaumont,* of Southport, Lancs. *176,246.* February 25th, 1921.

A rust-preventing composition for the protection of bright metal surfaces is made by mixing lard, blacklead and camphor in the proportions approximately of 16 : 4 : 1 respectively.

Continuous Centrifugal Machine.[2] *Joseph Avrutik,* of Yonkers, New York, U.S.A. *176,446.* November 8th, 1920.

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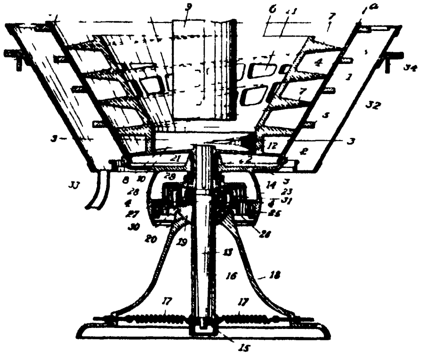
[1] In a recent article (*Boll. dell' Associazione Ital.*, 1921; *Centr. Zuckerind*, 1921, 191) Dr. VENDITTI states that he prefers to use five crystallizers, each one successively lower than the other, the massecuite travelling through each so that by the time it reaches the lowest its mother-syrup has become molasses. Starting with a massecuite of 93·7 Brix, 86·0 sucrose, and 91·7 purity, he obtained sugar of 97·1 pol., 0·77 ash, and 93·25 rendement, the composition of the molasses being 84·0 Brix, 12·8 sucrose, and 62·8 purity; and from this raw sugar he produced a white sugar of 99·65 sucrose and 92·42 rendement. Therefore, the advantage of his process is that it gives sugar and molasses with one boiling and crystallization.

[2] See also U.S. Patent, 1,360,708; *I.S.J.*, 1921, 300 and 324.

UNITED STATES.

Continuous Centrifugal Machine. ***Frank H. Lindenberg***, of Columbus, Ohio (assignor to the ***Jeffrey Manufacturing Co.***, also of Columbus, Ohio, U.S.A.). *1,393,193.* October 25th, 1921. (Four figures; six claims.)

As illustrated in the drawing, the improved separator consists, essentially, of an upwardly flaring perforated conical basket, adapted to rotation about a vertical axis, into which the material to be treated is introduced in a continuous stream, and from which the liquid is thrown through the perforations of the basket, while the tendency of the solids to climb on the inclined surface of the basket causes their discharge over its upper edge, this tendency to upward movement being controlled by a retarding device adapted to retain the material in the basket during a sufficient period of time to extract the desired proportion of moisture The separator basket consists of an upwardly flaring truncated cone *1* of perforated sheet metal, attached at its lower edge to the upturned flange *2* of the bottom plate 3. Upon its inner surface is a lining of wire mesh of sufficient fineness to prevent the escape of the finely divided solid material from which the liquids are being extracted. The perforations in the cone *1* are shown at *1a* and, although not delineated in detail, it will be understood that they extend continuously around the cone. A plurality of annular rings *5* attached to its outer surface, serves to re-inforce the perforated metal to prevent distortion of the basket under the strains of service.



Centrifugal action, caused by the rapid rotation of the basket *1* tends to move material upon its inner surface upwardly to be discharged over its upper edge. To retain the material in the basket for a sufficient period of time to effect the extraction of the desired proportion of the contained liquid, a retarding device consisting of a metallic cone *6*, the sides of which are concentric with and spaced apart from the separator basket *1*, is provided. Upon the outer surface of the cone *6* are formed spiral vanes *7* which extend outwardly to contact with the basket lining *4* to intercept the upward movement of the material upon the wall of the basket. At its lower edge the cone *6* is attached to a circular plate *8* upon which the material is received from the spout *9* and by the rapid rotation of which it is projected toward the side of the basket *1*, passing through the apertures *10* of the cone *6*. Relatively large apertures *11* are formed in the inner cone *6* in transverse horizontal planes above the bottom. The retarding vanes *7* revolve in the same direction as the separator basket *1* but at a slightly slower speed producing a screw action of the flights relative to the basket which permits the gradual upward movement of the material. The velocity of this upward movement depends upon the relative speeds of the two elements. Formed at the centre of the bottom plate *8* is a hub *12* which is fixed to the upper end of a vertical shaft *13* journaled in the ball bearings *14* and *15* within the vertical sleeve *16*. To the lower end of the sleeve *16* is attached a plurality of tension springs *17* extending radially therefrom and attached to the pedestal casting *18* to resiliently maintain the sleeve *16* in its upright central position. At the upper end of the sleeve *16* is a hemispherical expansion *19* which serves as the ball element bearing in the socket *20* of the pedestal casting *18* to form a ball-and-socket support for the rotative parts of the separator. At the centre of the bottom plate *3* of the separator basket is a hub *21* within which is formed a journal bearing *22* adapted to free rotation upon the outer surface of the hub *12* of the retarding element. An annular flange depending from the plate *3* concentric with the shaft *13* forms a pulley *23* of spherical contour, the centre of curvature of which is coincident with the centre of the ball *19* and socket *20*. Power to drive the separator is applied to the pulley *23* through a suitable belt *24* from any convenient source of power.

Decolorizing Carbon made from Bagasse and Lime, Defecation Scums, etc.

Russell W. Mumford (assignor to *Darco Corporation*, of Wilmington, Delaware). *1,402,007*. January 3rd, 1922. (No figures; seven claims.)

Bagasse is comminuted, and mixed (either when in a dry or a wet state) with a mineral matter capable of preventing the injurious clinkering effect of the natural ash of the cane. This mineral matter is preferably of calcareous character, e.g., milk-of-lime, mono-calcium phosphate and milk-of-lime, crude wood vinegar (pyroligneous acid containing acetic acid, tars, etc.) with milk-of-lime; or again, an intimate mixture of finely ground phosphate rock and milk-of-lime. For example, 70 parts of finely divided bagasse and 30 of lime in the form of milk are compounded into a dough-like mass in lumps or briquettes, slowly carbonized in a closed iron retort vented to allow the easy escape of vapours and gases as fast as formed, heated till the temperature reaches a point somewhat above 600° C., then finally cooled by blowing a little steam into the retort. Vapours or gases, steam, or products of combustion may be passed through the retort during carbonization (i.e., when the temperature reaches 100–200° C.) to expedite the removal of tarry matters when they tend to clog the pores of the carbon formed.

Decolorizing carbon thus made contains an excess of caustic lime, and the product mixed with water may be advantageously used instead of ordinary milk-of-lime, for simultaneously effecting defecation and decolorization, the juice being filtered from the precipitate produced. Or, the bulk of the lime may be separated from the carbon coming from the retorts by sedimentation, and, if desired, the rest removed by solution in hydrochloric acid. The final product is a more or less coarse powder, having open pores and a texture similar to the cellular structure of the original bagasse. It has a high degree of purifying and decolorizing power, and is particularly efficient in adsorbing viscous non-sugars from cane-juice; while further, it gives a perfectly bright liquid, no subsequent treatment with kieselguhr being necessary. Such a carbon made from a waste product and milk-of-lime is so inexpensive that it may be thrown away after use, though very advantageously the mixture of carbon and scums obtained after use may be added to more fine bagasse, and carbonized in the manner described, in order to recover both carbon and lime and make a rather better char.

Clarifying Agent consisting of Decolorizing Carbon incorporated in Kieselguh'

Russell W. Mumford (assignor to *Darco Corporation*, of Wilmington, D
ware, U.S.A.). *1,396,773*. November 15th, 1921. (No figures; six claim

Kieselguhr of good grade is made into a paste with an aqueous solution of an organic colloid, viz., starch (corn, potato, etc.) glue or gelatin, and with the starch solution some molasses, sucrose or dextrose may be added, though ordinary corn starch alone gives on the whole the best results. This paste or dough is formed into pellets of convenient size and charred in any way which gives a slow heating action with ample opportunity for the expulsion of vapours and gases. Thus the mixture may be charred in an ordinary vented retort, and a current of dry steam or products of combustion passed through during the charring operation. Or it may be made into thin layers in the bottom of shallow trays which are slowly advanced through a tunnel-like heating chamber containing surface combustion burners. In either case, the purpose in view is the deposition of the "primary carbon" in the pores of the kieselguhr, and the elimination of the tars, vapours, and gases before they can produce "secondary carbon" which may clog the pores of the kieselguhr. After carbonization has been completed and the mass has attained a temperature of 600°C., or above, it is cooled by dumping into water or blowing steam through the retort, or in other suitable manner. The decolorizing power of such a product is limited to some extent by the amount of carbon which can be deposited in the pores of the kieselguhr without clogging them; but the power can be increased to any extent by preliminary mixing with the kieselguhr and carbohydrates before charring a certain amount of peat lignite, etc., in powdered form and charring the whole as above described. In this way, the kieselguhr acts as the "spacing agent" mentioned in one of the inventor's previous applications.[1]

BAG FILTER FOR CANE SYRUP. *Arthur D. Stevens*, of Jacksonville, Florida. *1,404,667.* January 24th, 1922. (Three figures; five claims.)

Claim is made for a filter (presumably for use in the preparation of table syrup), consisting of a cylindrical receptacle with conical bottom around the upper portion of which receptacle is a flange supporting a plate carrying a plurality of filter bags which therefore depend into the receptacle. Resting on the plate above the entrance to the several filter-bags is a removable basket, containing kieselguhr, charcoal, &c., so that the syrup before entering the bags may be submitted to the purifying action of such materials.

CENTRIFUGAL FILTER. *Wilhelm Mauss*, of Johannesburg, South Africa. *1,404,157.* January 17th, 1922. (Five figures; seven claims.)

Claim is made in a centrifugal filter for a drum consisting of axially separable sections, a liquid receiver, a toggle locking the drum sections together when straight, suspending means for the drum movable through a definite space and so connected to the toggle that the weight of the drum tends to keep the toggle straight, and means to arrest movement of one drum section before completion of the movement of the suspending means, whereby continued movement of the suspending means breaks the toggle and separates the unarrested drum section from the arrested section.

LUMP (CUBE) SUGAR PACKING MACHINE. *Giuseppe Iacobitti*, of Crockett, Cal., U.S.A. *1,377,775.* May 10th, 1921. (Eight figures; fourteen claims.)

The object of the invention is automatically to pack cubes in a carton twelve lumps long, five wide and four high, the cartons after being piled being automatically placed in position in the machine and removed therefrom.

SEPARATION BY MEANS OF A DORR "THICKENER" OF THE TRICALCIUM SACCHARATE OBTAINED ON HEATING THE FILTRATE RESULTING FROM THE STEFFEN PROCESS OF RECOVERING SUGAR FROM WASTE BEET MOLASSES. *Phillip M. McHugh*, of Denver, Colorado, U.S.A. *1,402,079.* January 3rd, 1922. (Three figures; four claims.)

In the Steffen process of extracting sugar from final beet molasses, this product is diluted to about 12° Brix, cooled to about 15°C., treated with finely powdered calcium oxide, and the tricalcium saccharate thus formed filtered off in presses and washed. This is the so-called "cold process." Formerly the filtrate from the presses was considered waste water, and was discarded; but now the saccharate present in solution in it (probably as the monocalcium compound) is recovered by heating the filtrate to about 85°C., when almost all the sugar remaining in the liquid is thrown down as the insoluble tricalcium saccharate. This is the so-called "hot process."

According to this invention, after the filtrate has been heated (and the sugar thrown down as tricalcium saccharate), it is removed to a gravitational separator or "thickener," e.g., of the Dorr type, in which the tricalcium saccharate is settled out as a thick sludge and the clear waste liquor sent to the drain. This concentrated sludge is now filtered, preferably in continuous rotary suction apparatus, the tricalcium saccharate washed, and finally mixed with the tricalcium saccharate obtained in the so-called cold part of the process. Thus an important improvement, as compared with the usual practice of filtering the whole of the hot liquor through filter-presses, is effected. Installation and labour are both economized.

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[1] U.S. Patent, 1,286,187; *I.S.J.*, 1919, 357; in which the "spacing agent" is dolomite.

Sugar Crops of the World.

(Willett & Gray's Estimates of Crops to June 1st, 1922.)

	Harvesting Period.	1921-22. Tons.	1920-21. Tons.	1919-20. Tons.
United States—Louisiana	Oct.-Jan.	289,699	150,996	108,035
Texas	,, ,,	2,920	6,238	None
Porto Rico	Jan.-June	385,000	438,494	433,825
Hawaiian Islands	Nov.-July	480,000	508,392	496,183
West Indies—Virgin Islands	Jan.-June	5,000	4,500	12,400
Cuba	Dec.-June	3,500,000	3,936,040	3,730,077
British West Indies—Trinidad	Jan -June	52,000	54,933	58,416
Barbados	,, ,,	20,000	24,817	54,279
Jamaica	,, ,,	35,000	40,000	46,875
Antigua	Feb.-July	10,500	11,320	15,540
St. Kitts	Feb.-Aug.	8,000	8,063	10,036
Other British West Indies	Jan.-June	10,000	3,603	5,651
French West Indies—Martinique	Jan.-July	27,000	27,000	19,097
Guadeloupe	,, ,,	32,000	25,426	22,847
San Domingo	Jan.-June	225,000	185,516	175,736
Haiti	Dec.-June	10,000	5,625	4,125
Mexico	,, ,,	110,000	115,000	92,000
Central America—Guatemala	Jan.-June	19,000	17,500	15,100
Other Central America	,, ,,	18,000	20,000	20,000
South America—				
Demerara	Oct.-Dec. and May-June	90,000	96,168	85,356
Surinam	Oct. Jan.	10,000	12,000	7,169
Venezuela	Oct.-June	16,000	15,000	18,000
Ecuador	Oct.-Feb.	7,000	6,998	7,628
Peru	Jan.-Dec.	325,000	350,000	330,000
Argentina	May-Nov.	175,000	202,158	298,709
Brazil	Oct.-Feb.	325,000	340,063	177,155
Total in America		6,187,089	6,605,880	6,244,239
Asia—Brit. India (consumed locally)	Dec.-May	2,500,000	2,448,000	3,049,157
Java (1922-23—1,625,000)	May-Nov.	1,649,610	1,508,755	1,335,763
Formosa and Japan	Nov.-June	425,000	342,176	283,482
Philippine Islands, *exports*	,, ,,	276,000	255,843	209,336
Total in Asia		4,850,610	4,554,774	4,877,738
Australia (1922-23—300,000)	June-Nov.	298,701	182,401	162,298
Fiji Islands	,, ,,	65,000	73,000	88,000
Total in Australia and Polynesia		363,701	255,401	250,298
Africa—Egypt (consumed locally)	Jan.-June	100,000	79,706	86,712
Mauritius	Aug -Jan	200,000	259,872	235,490
Réunion	,, ,,	38,593	42,079	32,336
Natal	May-Oct.	150,000	151,500	142,851
Mozambique	,, ,,	52,000	50,000	38,746
Total in Africa		540,593	583,157	536,135
Europe—Spain	Dec.-June	5,000	6,886	6,048
Total cane sugar crops		11,946,993	12,006,098	11,914,458
Europe—Beet sugar crops		4,077,500	3,671,575	2,585,488
United States—Beet sugar crop	July-Jan.	911,190	969,419	652,957
Canada—Beet sugar crop	Oct.-Dec.	23,000	34,600	16,500
Total beet sugar crops		5,011,690	4,675,594	3,254,945
Grand total Cane and Beet Sugar	**Tons**	**16,958,683**	**16,681,692**	**15,169,403**
Estimated decrease in the world's production	**,,**	**276,991**	**....**	**....**

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1922. Tons.		1921. Tons.
Total Receipts, January 1st to May 24th	1,837,302	..	1,153,252
Deliveries ,, ,,	1,748,795	..	1,144,619
Meltings by Refiners ,, ,,	1,625,478	..	984,044
Exports of Refined ,, ,,	280,000	..	88,000
Importers' Stocks, May 24th	88,507	..	20,685
Total Stocks, May 24th	215,744	..	209,967
	1921.		1920.
Total Consumption for twelve months	4,107,328	..	4,084,672

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1919-1920, 1920-1921, AND 1921-1922.

(Tons of 2,240 lbs.)	1919-20 Tons.	1920-21. Tons	1921-22 Tons.
Exports	1,897,207	1,091,814	1,310,571
Stocks	672,948	1,071,857	997,291
	2,570,155	2,163,671	2,307,862
Local Consumption	32,500	42,000	50,000
Receipts at Ports to March 31st	2,602,655	2,205,671	2,357,862

Havana, April 30th, 1922.　　J. GUMA.—L. MEJER.

Beet Crops of Europe.

(Willett & Gray's Estimates to June 1st, 1922.)

	Harvesting Period.	1921-22. Tons.	1920-21. Tons.	1919-20. Tons.
Germany	Sept.-Jan...	1,330,000	1,152,960	739,548
Czecho-Slovakia	Sept.-Jan...	650,000	705,919	493,781
Hungary and Austria	Sept.-Jan...	68,000	47,977	12,151
France	Sept.-Jan...	275,000	305,041	154,444
Belgium	Sept.-Jan...	300,000	242,589	146,918
Holland	Sept.-Jan...	370,000	316,402	238,692
Russia (Ukraine, Poland, etc.)	Sept.-Jan...	100,000	89,071	78,013
Poland	Sept.-Jan...	225,000	189,834	140,000
Sweden	Sept.-Jan. .	227,000	164,194	145,072
Denmark	Sept.-Jan...	145,000	134,835	152,852
Italy	Sept.-Jan...	200,000	135,484	182,843
Spain	Sept.-Jan...	135,000	170,722	81,650
Switzerland	Sept.-Jan...	5,500	3,710	8,550
Bulgaria	Sept.-Jan...	22,000	7,837	10,974
Rumania	Sept.-Jan...	25,000	5,000	....
		4,077,500	3,671,575	2,585,488

Sugar Market Report.

Our last report was dated 9th May, 1922.

A considerable change in the position has been brought about in the past month, and it will be seen by the quotations given that prices have improved substantially, so that we are now on the top note of a rising market, as compared with the apathetic key of a month ago. One cannot forecast whether the movement will continue, since the interests concerned are so varied that some set-back is not impossible. One important fact to bear in mind is, that the world tendency is towards normal conditions, and it has not so far been possible to gauge the consuming capacity of the principal countries; we only know that there is, generally speaking, a trend towards increase, which becomes more apparent as Government restrictions are slackened. An illustration of this is given by the decree of the German Government, published on the 23rd ult., permitting the import of sugar into that country; and although it is difficult to separate cause and effect in this instance, or to say how far the decree was actuated by economic considerations, it was seen from official statistics that an appreciable quantity of imported sugar was required to balance consumption to the end of September next. Immediate advantage was taken of this permission, but uncertainty as to whether or when the embargo will be reinstated directed the demand to quickly available sugars, with the result that business in lots for shipment from London and the Clyde to German ports has proceeded actively, in addition to which good quantities of granulated have been bought for direct shipment from America. It is estimated that so far some 60,000 tons have been bought by Germany, but the amount of further requirements can only be conjectured, and depends upon the elasticity of the consumption under the new conditions.

Coming at a moment when trade was apathetic and people were wondering whether the continued abstention from buying on the part of India would result in pressure of White Javas on this side by tired holders, it is understandable that the creation of this new demand provided the impetus required to set the market in motion. The improvement in the value of white sugars which followed did bring White Javas within the required parity for the U.K., and some few thousand tons were sold for July shipment (mostly to speculators who were attracted by the position) at 18s. 9d. to 19s. c.i.f. London; later also for August shipment up to 20s. c.i.f. To-day business has been done in July at 20s. 4½d. and August at 20s. 3d., at which second-hand sellers appear willing to take some of their profits With business doing in White Javas for the U.K., it was thought by some that the moment of revival in India was imminent, and a certain amount of buying by merchant firms took place from 18s. c. & f. Calcutta, upwards, but owing to strikes and other uncertainties the demand has been disappointing. The local markets are without life, with prices well below first-hand parities Resales have been made up to 19s. 3d., which remains the second-hand value.

The Java market, on the other hand, has ruled firm in sympathy with American and London advices. Moreover, large quantities of both Whites and Browns are now being sold by the Trust to Japanese, Chinese and European merchants, and the tendency is upward. Near deliveries are tightly held owing to the late start of the crop; June is scarce and July shipments are sparingly offered. To-day first-hand sellers are quoting 19s. 6d. c. & f. Calcutta, July/August and July/September shipment.

Greater activity has been seen in the London Terminal market for White sugar, up to 22s. 6d. in bond being done for August and 22s. 4½d. for September. Reports as to lateness of Continental sowings and dry weather in Czecho-Slovakia and Germany have attracted buyers of October/December, which is now quoted at 21s. 7½d. buyers.

American reports show a firm tendency with a good demand from refiners and the interior. Large quantities of Cuban raws have been sold, and the falling-off in receipts has synchronized with a hardening of sellers' ideas. Up to 3 1/16 cent. c. & f. New York has been done for 96 per cent. sugar.

U.K. refiners have not responded to the rapid advance of the past few days. The last business done was in the neighbourhood of 14s. 4½d. c.i.f. as against to-day's asking price of 16s.

A very active business has been done in American Granulated in connexion with the German purchases and the improved demand from the trade here; June shipment is quoted at 20s. 9d., July at 20s. 10½d., August at 21s. c.i.f. U.K. ports.

London refiners' prices are advanced to 55s. 3d duty-paid for No. 1 Cubes, 49s. 9d. for London Granulated. Small remnants of Mauritius Crystals on the spot sold at 45s. 6d. duty-paid, and are now quoted 46s. 9d.; American Granulated Spot, 48s. 9d. to 49s.

H. H. Hancock & Co.

10 & 11, Mincing Lane,
London, E.C. 3,
June 9th, 1922.

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

The Improvement in Sugar Prices.

Consumption has been overtaking Production in the sugar world the last six months and this is now reflected in brisker market transactions and upward tendencies in prices. At the outset of the new year Cuba was faced with a surplus of unsold old crop sugars of nearly 1¼ million tons, which it was feared would not be easily disposed of. But the general drop in retail prices the world over has created an increased demand, accentuated by the fact that Continental beet is still far from satisfying the present normal requirements of European consumers, so Cuba got rid of her stocks at an unexpected rate and has none of the old crop left, while she has disposed of about three-fifths of her new crop. Germany, *mirabile dictu*, is in the market as a purchaser and, as our Continental correspondent points out elsewhere, will need a considerable amount to tide over the gap till her next beet crop, though he thinks she will try and keep the import down to 100,000 tons. This will go to serve the needs of the trade sugar users, while the public will be rationed for their domestic supply to 2 lbs. a month the rest of the summer, or about the amount we in this country had to rest content with in the worst days of the wartime sugar shortage. The latest figures of world production (according to WILLETT & GRAY) estimate an increase during 1921-22 season of 543,151 tons as compared with 1920-21. Most countries show decreases, the principal one being perhaps Mauritius with about 60,000 tons less. On the other hand, Louisiana, San Domingo, Java, Japan, Australia and European beet all show marked increase.

But for the present, the demand is forcing prices up, and the experience of the United States market (to quote a Report of LAMBORN & Co. towards the end of June) is a symptom. There new high price levels had been established, Cuban raw selling up to 3¼ cents c. & f. (4·86 cents duty paid). The demand from the domestic trade has now become the most important factor on the American market. Hitherto it has lagged behind and left Europe to buy freely of raw and refined. Europe's purchases have been far in excess of general expectations and consequently Cuba has disposed of so much of its sugar that its statistical position is steadily strengthening, and placing producers in a more independent position. Europe's purchases of refined from U.S. refiners have also been of such volume as to materially interfere with the refiners' ability to meet the demand for domestic consumption. Now that the States are in the midst of their heavy consuming period, demand from the domestic trade is having its effect and is being reflected to a greater extent by the large amount of foreign business on the refiners' books, their inability to satisfy this demand promptly and the more favourable position that Cuban producers have attained. More recently the latter have shown little desire to meet Europe, preferring to sell their sugars in the States where they were entitled to a preferential duty, and to take advantage of that duty. But with stocks decreasing steadily and production practically at an end Cuban producers are very reluctant sellers. "The steady advance in price is not bringing out increased offerings but on the other hand resulting in increased indisposition to sell other than gradually and on a scale up. Producers are steadily improving their financial position and consequently are better able to market conservatively. Even though Cuba has exported almost 3,320,000 tons of sugar so far this year, many producers there feel that at the end of the crop year there will be little unsold sugar on the Island. The marketing of this record breaking volume of sugar does not appear to have resulted in the accumulation of any large reserves in distributing and consuming channels. Some reserve has without doubt accumulated but both Europe and the United States had permitted their surplus or working stocks to fall to such low levels last year that the increased consuming inquiry was more severely felt. At the close of last year Cuba was carrying practically all the reserve supply of sugar in the world, as was indicated by the fact that even the Far East, a heavy producing section of the world, was a purchaser in that market. Cuba's reserves are rapidly disappearing and with production near an end, stocks will without doubt rapidly decline."

The Home Beet Industry: Parliamentary Debate.

On June 20th last the House of Commons, sitting in Committee on the Finance Bill, debated that clause which authorizes the omission of the Excise Duty on home-grown beet sugar. Several amendments were down for discussion, which either aimed at rejecting the clause *in toto* or else at limiting the benefit to sugars not exceeding 97 degrees of polarization. Much was made by the opponents of the enormous amount of the "subsidy," which comes to 25s. 8d. per cwt.; but no attempt was made to visualize it in its true proportions which, at the present rate of output (and that which is likely to be achieved for some years to come), are comparatively small and a mere drop in the bucket of our total sugar imports. Mr. Leonard Lyle, speaking for the refiners, disclaimed any wish to put a spoke in the wheel of an infant industry, but since he pressed for the favoured sugar to be limited to the polarization above referred to, he showed, as Sir Robert Horne was able to point out, that the refiners are out to get the business which at present is being done by the two factories themselves, that is the refining of the latter's own raw sugar. Mr. Lyle argued that every man put into the sugar beet factory takes away a man from the sugar refineries; that contention might have some substance if our factories turned out 50,000 tons or so of sugar and our consumption was up to the high-water mark. But our consumption is elastic and will tend to expand for some years, and even 20,000 tons more or less is hardly likely to create "out-of-works" amongst refinery employees. Just as questionable was Mr. Lyle's contention that of Austrian and German sugar-producing factories before the war not more than five or six turned out white sugar, and that therefore (the precise phrase is ours and not Mr. Lyle's) it would be the height of presumption for these two infants (Kelham and Cantley) to attempt to do otherwise and refine their own raws instead of handing them over to the established refineries. Whatever the number of those pre-war Continental white sugar factories, it is surely more to the point to enquire how many there are now, and a glance at the latest handbook of the German beet sugar industry suggests that upwards of fifty of the German raw sugar factories turn out in part or in whole grades of sugar fit for going into direct consumption. Moreover, some of the German so-called refineries would appear to be merely crystal washing stations and not proper char refineries. But it is a pity Sir ROBERT HORNE, in replying to Mr. LYLE, was seemingly unaware of the example of the big American beet sugar industry, which last year in 92 factories turned out over a million tons of beet sugar that went into consumption without passing through a refinery. It is in America that the tendency to amalgamate the two processes has been carried to the pitch of perfection, and it is singular that in the whole of the debate, which covered 19 pages of the official report, there was no reference to American practice.

Apart from the Government spokesman (Sir ROBERT HORNE), the best contribution to the debate was made by the Labour Member for Norwich, Mr. G. ROBERTS, who, representing the district that supplies Cantley with beetroots, has some first-hand knowledge of the agricultural side of the subject. He emphasized that you must make and refine sugar in a modern sugar factory, it being obviously an uneconomic proceeding to convey the beets to a factory to be turned into raw sugar and then have to convey the latter to a refinery to have the final process gone through. From the agricultural point of view there was no doubt the growth of sugar beet was a real help in the system of rotation, since it is a crop which has the quality of cleaning the soil and brings large numbers of persons on to the land. He had every reason for believing that in the course of a few years with the aid of this remission of duty—bearing in mind that every country with which we have to compete has built up its sugar industry on aid from its own Government—we would have established in this country on a sound basis a sugar beet industry which would develop rapidly. He knew that there were already schemes in existence for the creation of new factories, so great was the confidence already inspired among agriculturists and others in the prospects of this industry.

SIR ROBERT HORNE in defending the Government's policy put the matter in a nutshell when he pointed out that if we exact the Excise duties to-day it is certain that neither of those factories could carry on, so that there would either way be no duties to collect. The Government were, however, also impressed with the necessity of helping an infant industry which was approved by agriculture generally and which gave what he declared was a large amount of employment on the land and in the factory. But he concluded with the warning that if the industry does not justify itself in the future, it must undoubtedly cease to have the support of the State.

In the end the clause was carried by 267 votes to 88.

Kelham-Cantley Amalgamation a Probability.

It now remains for Cantley and Kelham to come to some arrangement of amalgamation so as to reduce expenses, and then to carry on the next campaign as efficiently as possible, at the same time making every effort to achieve next year a greatly increased acreage of beets. The Government are certainly right to persevere with the experiment of beet growing in this country even though they lay themselves open, as was urged in the parliamentary debate, to a charge of bolstering up a financial business that was practically on the rocks. But the financial position is not always the one to consider; there is the producing side, and Kelham though grossly over-capitalized is a going concern of some value and the machinery of an experiment that is worth prolonged trial. For this reason it is just as well the Government have not yet decided to cut their losses. But if any of the other factories referred to by Mr. G. ROBERTS, M.P., materialize, it will be necessary to finance and manage them on much more stringent lines than was the case with Kelham. In their case there will be no excuse for failure to pay their way.

What Preference has done for Cuba.

In an article entitled "American Producers of Sugar in Cuba" which Mr. TRUMAN G. PALMER, the well known American sugar statistician, contributed to a section of "Concerning Sugar" issued last May,[1] two main points stand out: the extent to which American reciprocity with Cuba has built up the latter's now gigantic sugar industry; and secondly, the extent to which the American capitalists are getting a hold of that sugar industry. We quote below extracts from the article detailing these two points.

First the working of the preference. "In 1898 (writes Mr. PALMER) the year the United States freed Cuba from the yoke of Spain, the island's sugar output amounted to 342,208 short tons. In 1901, when at the instigation of the American Sugar Trust the Cubans joined the Trust in the agitation for commercial reciprocity with the United States, the Cuban production had increased to 686,310 tons. In 1903, when the commercial reciprocity treaty became effective, the output had reached 946,447 tons. The treaty gave Cuban sugar a preferential of 33·7 c. per 100 lbs. and in 1914, when the world war began, Cuba's output had reached 2,909,460 tons, which, with the domestic production of 2,194,530 tons in continental and insular United States, provided 892,000 more tons than the latter's entire sugar requirements. Under the terms of the reciprocity treaty, Cuba's preferential is on a percentage basis—20 per cent. lower than the U.S. tariff on sugar from other countries, and it works to give Cuba an advantage, whether the U.S. rate of duty be increased or decreased. An increase of duty of $1·00 per 100 lbs. automatically increases Cuba's preferential by 20c. per 100 lbs., thereby strengthening her ability to prevent the U.S. importation of Javan, Santo Domingan and other foreign sugars. Thus the emergency tariff bill of May 24th, 1921, which increased the U.S. duty 74·4c. per 100 lbs., automatically increased the Cuban preferential 14·9c. per 100 lbs.

American Capitalistic Expansion in Cuba.

The healthy expansion of Cuba's sugar industry through the working of the American preference has naturally led to a very considerable development of American capital enterprise in the island. This process has been greatly assisted by the upheaval elsewhere owing to the war. For it was with the beginning of the world war that capital began to pour into Cuba at an unprecedented rate. The result was that in 1919 Cuba produced 4,448,839 short tons or within 106,000 tons of the total amount of sugar consumed that year in the entire United States. And 84·75 per cent. of this expansion was due to American-owned mills, some of which were greatly enlarged and others newly erected, thereby increasing their output 1,340,154 tons, while the output of all the other Cuban mills increased only 241,292 tons or 15¼ per cent.

. There are 85 American-owned mills, according to Mr. Palmer, the combined annual capacity of which (based on the best average of each of the past five years) is 3,116,942 short tons of sugar, equal to 70 per cent. of the total amount of sugar produced in Cuba in 1918-19, the year of the island's greatest production. Of these mills, 49 are either owned outright by American seaboard sugar refining companies or are affiliated with them. The American Sugar Refining Company is responsible for 2, the W. J. McCahan Sugar Refining and Molasses Co. for 21, the National Sugar Refining Company for 14, the Pennsylvania Sugar Company for 6, the Revere Sugar Refining Company for 2 and the Warner Sugar Refining Company for 4. These forty-nine mills have an average capacity of 47,572 tons per mill, and a total of 2,331,033 tons, equal to 53 per cent. of the total Cuban sugar production of 1920-21. The other 36 American-owned mills are independent of U.S. sugar refining companies; these have an average capacity of 21,831 tons. The output of the 113 Cuban and European-owned mills in 1921 was 18,088 tons per mill.

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[1] Concerning Sugar (Loose Leaf Service). By TRUMAN G. PALMER. Price by Subscription $12 per annum. (901, Union Trust Buildings, Washington.)

Further, as showing the great holding the American capital interests possess in Cuba, it is stated that the total value of their assets in the island now amounts to $621,219,766 and that these American companies own and control 4,459,407 acres of cane land which (at an average of 2·46 tons of sugar to the acre) would produce 10,970,000 tons of sugar. Of this acreage, the refining interests control just 75 per cent.

Cuba's Future Prosperity.

As for the future outlook in Cuba, we might do worse than quote from an article in the *Cuba Review* on "Some Sugar History," where H. O. NEVILLE outlines the history of Cuba's sugar industry from March, 1921, to March, 1922. His concluding remarks on the future prospects of Cuba in this respect are decidedly optimistic. Those, he states, who are familiar with the island of Cuba and its people and with the vast amount of capital that is involved in the establishment of sugar properties, can readily understand that, once established, conditions must be very serious to prevent continued operations. That the nominal owners of many of the Cuban mills are in such financial condition that they undoubtedly could not continue operating is well known, but the debts incurred by them have been so great that their creditors are compelled to continue operating the property or else to lose considerable sums. For this reason, aside from some of those mills which this year have not already commenced to operate, he believes that the future will not see the cessation of work by any considerable number of mills. The production of many of them will doubtless diminish, due to inability to obtain at the prices that will be current for sugar a sufficient cane supply to allow them to operate to full capacity. But the fact remains that Cuba is intrinsically and by nature a sugar producing country. Nowhere else in the world, in the opinion of Mr. NEVILLE, are all conditions quite as favourable for large heavy total production at a low cost as are those in Cuba. The newer lands of Oriente, Camagüey, and eastern Santa Clara Province will produce very cheap cane for a great many years, while many of the older areas, especially in Matanzas, will continue for a long time producing cane at no more than a reasonable cost. In Pinar del Río Province cane producing will disappear from a considerable area now occupied by sugar and in Havana Province conditions are favourable to the lessening of the area planted to cane and to the extension of the area planted to other crops, so that in all probability in these two provinces quite a considerable decrease in production may be observed by next crop; but Mr. NEVILLE believes that the total sugar production of Cuba will be maintained for a good many years at a quantity very much above the largest amount produced in any year previous to 1914, and that

Cuban producers will be able to compete so successfully with other countries that the production of the latter will diminish, leaving the proper balance between total world supply and world demand.

The West Indian Agricultural College.

It is anticipated that sufficient progress will have been made with the fitting up of temporary laboratories and class rooms at St. Augustine, Trinidad, the seat of the West Indian Agricultural College, to permit of a limited amount of work of tuition and research being started in October of this year.

It is proposed to offer a three years' course of study leading to a diploma in tropical agriculture. The object of this course will be to train those desirous of following the business of tropical planting, and those who wish to become experts in particular branches of tropical agricultural technology. The general scheme of the curriculum can be seen from the list of studies detailed below ; these with the exception of Book-keeping, Economics, and Veterinary Science are intended to cover a period of three years. Laboratory and field work will be made predominant features in the study of all subjects. The list comprises : Agronomy, Botany, Chemistry, Sugar Technology, Mathematics, Physics and Elementary Engineering, Zoology and Entomology, Mycology and Bacteriology, Soil Science, Veterinary Science and Animal Nutrition, Book-keeping and Economics, English Language. In connexion with Sugar Technology, it may be added, it is anticipated that as soon as the college has been fully established special facilities will be provided for special study in a model sugar factory. In the meantime as a start, provision will be made for class room and laboratory instruction in the general principles of the subject.

Diploma course students will be required to pass the College entrance examination unless they have matriculated at a British University or have passed the Cambridge or Oxford Higher Local Examinations. Students must have attained the age of 17 years. The fee for tuition for the Diploma course will be £50 per annum, the college year being from October 1st to July 30th. But there will be certain reduced fees for certain nominated students.

For further information on the subject, including synopses of the various studies, application should be made to the Secretary of the West Indian Agricultural College, 15, Seething Lane, London, E.C. 3, or to the Principal, St. Augustine, Trinidad.

Home Refinery Statistics.

Messrs. TATE & LYLE, LTD., of Liverpool, have just issued their interesting annual Chart, detailing the sugar supply of the United Kingdom, the imports of raw and refined sugar from all sources for ten years, the quantity produced by home refineries, etc. From it we glean the following particulars for 1921, the corresponding figures for 1920 being in brackets. Imports of raws: Cane 801,153 tons [1,236,397], Beet 13,685 tons [15,147], the percentage of the two sorts being thus 98·3 to 1·7 [98·8 to 1·2]. Imports of refined: Cubes 11,550 tons [84], other grades 462,912 tons [121,598], the percentages being 2·4 and 97·6. The total imports thus came to 814,838 tons of raws or 63·2 per cent. and 474,462 tons of refined or 36·8 per cent. The refined sugar produced by the home refineries came to 825,319 tons, or 63·5 per cent. of the refined sugar available in this country for consumption or re-export. There is, however, no indication as to what proportion of the imports of raws went into consumption unrefined and the total of the quantity of refined sugar available for consumption is greater than the total import plus the home beet production (which was 6300 tons), showing that stocks of raws imported during 1920 entered into the refining output of 1921. But such overlapping is inevitable.

Fifty Years Ago.

From the "Sugar Cane," July, 1872.

EUGENE FELTZ in this issue of our predecessor gave the results of works trials on a moderate scale with the osmose process in Russia. Excellent results technically and economically were stated to have been obtained. Thus, whereas third sugars when worked up would give 9-10 per cent. of yellow pieces, in the case of the osmosed thirds 20-25 per cent. were obtained, 22 per cent. being a fair average yield. Moreover, crystallization was very much more rapid when the new process was operated; and it was further observed that while the osmosed molasses contained 19·75 per cent. of salts, ordinary molasses had as much as 35·65 per cent. It was claimed that very little extra labour was required, and that "the using of osmogenes is so regular and of such slight expense that the employment of the osmose as a process of purification should be introduced into sugar factories. . . . . ."

Since this paper was published the osmose process has been given a good deal of attention, and it is now generally considered to be unremunerative under present conditions. In favour of the process, it may be said that it is quite easily carried out; that it requires little room; and that the apparatus necessary is simple and inexpensive. On the other hand, against it stands the fact that, after the first osmosis, the process must be repeated several times in order to bring down the salt content to a practicable limit, and that the further the osmosing continues, the greater is the amount of water to be evaporated from the purified liquor for the graining of the sugar it contains. Therefore, though osmosis may prove remunerative when molasses is particularly cheap, and the price of sugar is normal or rather above its usual price, it is not otherwise financially sound.

There were one or two other papers of a little interest which appeared in this number of the *Sugar Cane*. An extract from a New Orleans paper recorded the fact that at this time the "Ribbon" cane then almost exclusively planted in Louisiana was rapidly degenerating. It was "now more delicate and puny in its growth, more easily affected by frost, and more subject to decay in windrow, or mattresses put up for seed. The stubbles will not keep sound after the first year. In fact, the juice tastes like sorghum or cornstalk juice, and requires more boiling to make it granulate, and yields double the molasses it used to do. . . . . In short it is getting worthless." It was decided to send an expert on a voyage to Penang and Java in order to examine the question of importing stocks of the varieties regarded as the most suitable for Louisiana conditions.

An article from the *American Chemist* stated that "the question of the desirability of the general introduction of the beet sugar manufacture into the northern parts of the United States and Canada had been under consideration for some time past"; and the results of experiments made by Dr. C. H. GŒSSMAN at the Massachussetts Agricultural College are here recorded. These showed that French and German seed when planted on the college farm had given roots containing 5-13 per cent. of sugar, but the yields per acre were not stated.

Lastly, ALFRED FRYER wrote a note pointing out that in his opinion the diminished rainfall which had been observed in certain sugar colonies was due to the destruction of forests. In favour of this view, he quoted the opinion of observers such as HUMBOLDT, BOUSSINGAULT, and HERSCHELL.

The Position of the Sugar Industry in the British West Indies.

Report of the Under-Secretary for the Colonies.

In consequence of representations made to the Secretary of State for the Colonies (Mr. Winston Churchill) in the House of Commons last year, which expressed the growing demand in several of the West Indian Colonies for the bestowal of a measure of representative Government, the Hon. E. F. L. Wood, M.P., Parliamentary Under-Secretary of State for the Colonies, paid a prolonged visit to the West Indies and British Guiana during last winter and discussed on the spot with responsible parties a very considerable number of constitutional and also economic questions. He was made very fully acquainted with all the conditions ruling in that part of our Empire; and the result on his return home is a detailed Report which has just been presented to Parliament. That portion of it which relates to the sugar industry is reproduced *in extenso* below; it will be found interesting as being a succinct account of the general position in that industry and a reasonable argument in favour of its continued support by the Imperial authorities.

PRESENT DIFFICULTIES.

The West Indian Colonies have been, and still are, suffering from acute economic depression in this industry. Strong representations with regard to its present state were made to us in practically every one of the Colonies visited, and I am satisfied that on the economic side there is no West Indian problem which more urgently demands the attention of His Majesty's Government.

The present difficulties of the sugar industry are due to various causes, of which the chief is the unprecedented fall from the boom prices due to the war to a price which at its lowest (on December 28th, 1921) amounted to £8 2s. 4d. per ton c.i.f. New York (equivalent to 10 guineas per ton c.i.f. United Kingdom), the lowest price for 19 years. To this figure should be added, in order to arrive at an approximate estimate of the net price to the producer, say £3 per ton in respect of the proportion of the preference received by him, and from it should be deducted say £2 a ton in respect of insurance and freight, making the net price to the West Indian producer, say, £11 10s. per ton in the English market. The comparable pre-war price was £9 to £9 10s. a ton f.o.b. It is, however, fair to add that since December 28th, 1921, the prices have been rising, and on March were £2 per ton more than in December. This, however, still means that the producer receives less than £14 per ton for his sugar.

While I was in the West Indies, it was generally represented that sugar could not be produced remuneratively in the Colonies unless the producer could get £15 a ton for his product. The present price in the United Kingdom, even with the whole of the preference added to it, is not enough to secure this return.

A further factor, which has produced the present economic depression in the industry, has been the falling off in the demand for the most important by-product of the industry, viz., rum. Deliveries of rum for home consumption in the United Kingdom last year amounted to 2,036,532 gallons as compared with 3,331,009 gallons in 1913, while stocks have reached the abnormal figure of 11,689,000 proof gallons. Before prohibition America imported large quantities of rum from Jamaica, while previously to the war a special trade in British West Indian rum was done with Germany. Both these markets are now lost, and the United

Kingdom consumption is prejudicially affected by the present high rate of import duty.

Nor is it enough to say that the sugar industry had previously during the war enjoyed a considerable period of favourable prices. In the case of the West Indies, the industry had been carried on for such a long time on a narrow margin of profit that most of the estates were heavily mortgaged, and their machinery was antiquated. Much of the profits, earned during the years of prosperity, were necessarily devoted to paying off charges and to buying new machinery at war prices. Moreover, in regard to firms domiciled in the United Kingdom owning estates in the West Indian Colonies, the difficulties of setting aside proper reserves were accentuated by the Excess Profits taxation claimed by the Imperial Exchequer.

One further consequence of the boom must be noted. The bankers made large advances on the basis of the prices which it was expected in 1920 that the sugar crops would yield. When the slump came, not only did many estates find themselves involved far beyond their expectations, but the bankers had committed themselves to such an extent that they had in many cases to refuse all further advances. Consequently, the local Governments have had to take special steps to meet the unprecedented situation, notably in Jamaica, and now in Barbados and British Guiana. These measures are, however, essentially unsound, since they involve guarantees to the banks for the bankers' own business of financing the crops in those Colonies, are emergency measures which cannot be continued or repeated, and involve liabilities which cannot be met unless the sugar industry is restored to solvency.

Reasons why the West Indies looks to the United Kingdom for help.

Under these circumstances the West Indies looks to the United Kingdom for some assistance, and there are several factors which justify them in this attitude.

(*a*) The United Kingdom has given preference to the Dominions and Colonies principally as a token of Imperial solidarity. Preference in the West Indies, however, has been established partly as a token of Imperial solidarity, but partly also as a result of bargaining with Canada for special advantages to the West Indies in return for tariff concessions made by the West Indian Colonies to Canada. These concessions, which were over and above what the West Indies would have normally granted in recognition of the obligations of Imperial solidarity, the United Kingdom insisted on having extended to herself when the negotiations with Canada were completed. The amount of the preference given by the United Kingdom to the West Indian Colonies (apart from cigars, wines, spirits and certain other miscellaneous articles not affecting the West Indies) is 16⅔ per cent., whereas the preference provided for under the agreement between the West Indies and Canada varies from 33⅓ per cent. to 50 per cent., except in the case of Jamaica and the Bahamas, where it is 25 per cent. (Jamaica has, however, already given a preference of 40 per cent. on cotton piece goods from the United Kingdom.) The West Indies, therefore, think that the United Kingdom, in securing the "Canadian" rates, is getting the best of the bargain, and inasmuch as our policy of enforcing on the West Indies an extension of preference in favour of the United Kingdom costs money to the West Indian taxpayer, they not unnaturally feel entitled to press for more equal treatment.

(*b*) The United States gives a preference to Porto Rico amounting to 2 cents per lb., equivalent at present rates of exchange to about £10 per ton, whereas the United Kingdom rate (on sugars not exceeding 96° polarization) amounts to

£3 15s. a ton. The effect of American policy in regard to Porto Rico is shown by the following figures:—

	$
Total value of imports into Porto Rico in 1899..........	9,805,916
Of which the United States supplied	3,984,369
Total value of imports into Porto Rico in 1920..........	96,338,534
Of which the United States supplied	90,724,264
Total exports of Porto Rico in 1899	10,156,541
Total exports of Porto Rico in 1920	150,811,449

The British West Indies cannot help contrasting this development with their own and draw the inevitable conclusion.

(*c*) The American preference to Cuba is 0·4 cent. a lb., i.e., about £2 per ton, but the production in Cuba amounts to about 3,500,000 tons, of which about 1,300,000 tons is surplus over and above the amount that can be absorbed by the American market. This Cuban production must be sold somewhere, and as Cuba possesses certain natural advantages—unexhausted soil, factories on a larger scale, e.g., capable of dealing with 50,000 tons of sugar per year instead of 7000 tons or less in the British West Indies, and above all very large investments of American capital—the West Indian producer fears that the Cuban surplus will be dumped, in spite of the British preference, at rates with which he cannot compete in the British market. These fears are at the moment strongly reinforced by the formation in the United States of an organization called the Sugar Export Corporation, for the express purpose of refining Cuban sugar in bond and of marketing the refined products in Europe.

(*d*) The possible competition of beet sugar from countries with highly depreciated exchanges, like Czecho-Slovakia, makes the outlook for the producer uncertain. Against this contingency no relief is obtainable under the Safeguarding of Industries Act.

WHAT THE WEST INDIES ASK.

To meet this position the West Indies advance the following request:—

That the present rate of preference in the United Kingdom should be doubled, i.e., increased from one-sixth to one-third over a period of years, preferably equal to the period of ten years for which the West Indies are bound to Canada under the existing arrangement, and for which they have undertaken to give their present high rate of preference to British goods, and also that an undertaking may be given that should the sugar duties be reduced during that period the substantive preference on British sugar should not be allowed to fall below the present figure—namely, in the case of 96° test sugar approximately £3 15s. a ton. I would add, parenthetically, that representations have already been made from the West Indies to the Canadian Government asking that the Canadian preference may be doubled.

So far as the continuity of the principle of preference is concerned, their views have been already met by the undertaking given by His Majesty's Government that, subject to the approval of Parliament, preference at the existing proportion of one-sixth of the duty shall be maintained during the period of the Canada-West Indian Agreement. But valuable as is this concession, it is urged that it only partly meets the West Indian situation, and that for the reasons given above the existing preference of 16⅔ per cent. is inadequate to safeguard the industry. Moreover, those concerned are apprehensive that the present proportionate preference of one-sixth might diminish to vanishing point, if there was a substantial reduction in the sugar duties. It is to meet this possibility that they desire His

Majesty's Government to undertake to maintain for the period specified a minimum preference of £3 15s. per ton.

RECOMMENDATIONS.

I would strongly recommend that, having regard to the political and economic issues here advanced, this request should be favourably considered.

It is impossible that any concession granted to the sugar industry should be limited to the West Indies, as it would be open to the objection of favouring one part of the Empire as against another, and it is obvious that the first consequence, which a doubled preference would entail upon the United Kingdom, must be an immediate prospective loss of revenue. If the preference were doubled, the loss would amount to say £1,200,000 on the imports from the British Empire. On the other hand, it must be remembered that the sugar industry, more than any other in the West Indies, is carried on with capital invested from the United Kingdom, which pays taxes in the United Kingdom. If sugar becomes an uneconomic proposition, these estates will go out of cultivation, and the United Kingdom will lose, not merely the capital which has been invested, but also a considerable source of taxable revenue. Other tropical products do not require investment of capital on the same scale. Secondly, the sugar industry in the Colonies provides more employment per acre and more revenue per acre than any other crop. The effect of closing down the sugar estates would be to produce a state of the gravest financial embarrassment, and to create serious unemployment in the Colonies, which are largely, or in some cases entirely, dependent on the sugar industry. It is not impossible that their difficulties would be so great that an appeal would be necessary to the British Treasury for a grant-in-aid to enable them to carry on at all, thus repeating the unfortunate history of 1897.

At the present moment the outlook is so uncertain that planters are tending to give up sugar and go into other crops, thus increasing the dependence of the United Kingdom upon sugar produced on foreign soils. They are unwilling to-day to invest money in new machinery. The only way to ensure orders for such new machinery in the United Kingdom, and to secure an Empire-grown supply of sugar, is to show that His Majesty's Government intend to pursue a policy which will encourage the industry to look forward to a reasonably assured economic future over a period of years.

Finally, it is right to remember that the stability and progress of the West Indies are largely dependent upon the presence of a European element. The sugar industry, being pre-eminently one which cannot be carried on without a European staff to organize and direct the local labour, is the chief means of attracting and maintaining the European population. From the political, social, commercial and Imperial point of view, it is vital that this element should be maintained, and this can only be done by preserving the sugar industry in those Colonies where it still exists. It is, therefore, not only on economic but also on political grounds that I would recommend that His Majesty's Government should consider with sympathy the proposals of the West Indies in this matter. I realize the danger of demands from other quarters for an extension of preference on other products such as cocoa, but it must be borne in mind that when the preference was first initiated, it was only sugar producers who pressed for a change of policy from the point of view of assistance to their industry. In the case of tea, coffee and cocoa, no such strong demand existed, and I do not anticipate difficulties from those quarters. Even in the case of the West Indies, the demand for an increased preference on cocoa is not likely to be urged, seeing that so large a proportion of the production comes from the British Empire, and preference therefore gives little or no advantage to the producer.

The Deficient Sugar Supply in Germany.

(From our Continental Correspondent.)

According to official data the conditions in Germany of sugar production, consumption and stocks at the end of April were as follows:—

	Metric Tons.
Initial stock on September 1st..	63,662
Production till 30th April	1,288,642
Consumption of imported sugar	8,202
Total supply	1,360,506
Final stocks on 30th April	420,972
Consumption (8 months)	939,534

All these figures represent metric tons raw value. It appears from them that on September 1st, 1921, Germany entered into the new campaign with the very small initial stock of 63,662 tons of domestic sugar, on which the country had to live till sugar from the 1921-22 crop became available. Besides this there was a small stock of imported sugar, from which only 8202 tons were consumed during the period under consideration.

Up to the end of April the country produced 1,288,642 tons of sugar; there will still be some sugar turned out by sugar factories of establishments for the extraction of sugar from molasses, but the total production will not exceed the figure of 1,300,000 tons by any appreciable amount. In the eight months under review the country consumed 939,534 tons of sugar, or considerably more than during the corresponding period of 1920–21 when the amount consumed was only 717,423, against 646,342 tons in the same months of 1919–20.

We understand that the industries which use sugar as a raw material, those for the confection of chocolates, liquors, cakes, candies, etc., have purchased uncommonly large quantities and helped to decrease the stocks, so as to cause serious uneasiness in Germany. The consumption of 939,534 tons in eight months is equivalent to one of 1,400,000 per annum and, even if we assume a total production of 1,300,000 tons, it can be seen that the combined initial stocks and total production are unable to supply sufficient till even the 1st of September, when the new statistical year begins but when no new beet sugar is to be had.

Early this calendar year, it became evident to anybody who was able to read statistics that in Germany sugar supplies would run short before the new sugar crop and that unless consumption was rationed again or sugar allowed to be imported, the sugar users would be confronted with a total lack of sugar this summer.

The figures for the importation and exportation into and from Germany for the period 1st May, 1921, to 30th April, 1922 (also expressed in metric tons raw value) are given on next page.

The result is that a comparatively small amount of sugar has been imported in the period under discussion, while half the amount of the importation has been sent to the one-time German regions, with which commercial relations have still been maintained. This small importation could by no means make up for the scarcity to be feared in the early summer months; and that is why the Government has temporarily suspended the importation duty on sugar, which amounts to 40 marks gold or 1400 marks paper per 100 kg. This very high duty had prevented any importation to speak of; but, even without any duty, the sugar price on the world's market was higher than the one at which sugar was being sold retail in Germany. Sugar was to be had in the shops at 15 marks per lb., while the price for foreign refined, even without the importation duty, but only the consumption duty of 50 marks paper per 100 kg., was anything like 20 marks per lb. The wholesale importation of foreign sugar would therefore drive up the price of sugar for the common use, a contretemps the Government has desired to prevent.

Imported from	
Netherlands	5313
Dutch East Indies	2798
United States	292
Czecho-Slovakia	8120
Poland	2626
Switzerland	20
Denmark	124
Belgium	4934
Sweden	3936
Danzig	6324
Other countries	2395
Total importation	36,846

Exported to	
Danzig	6259
Saar territory	11,263
Other countries	624
Total exportation	18,146

After some negotiations the committee which has been charged with the distribution of the home consumption, has resolved to distribute the sugar which is still left for household use only, save a small allotment to bakers. Every manufacturer of chocolates, candies, liquors and similar descriptions, has now to import the sugar which he will need. It has been calculated that on July 1st only 200,000 tons of domestic sugar will be left in Germany, which quantity will have to last till mid-October, or for 3½ months. Divided among the inhabitants it would mean a monthly ration of 2 lbs., while the sugar-using industries will have to fall back on the more expensive foreign product, for which they are free to charge in the high price of their goods.

As soon as it became known that the importation duty was to be suspended, every parcel of Czecho-Slovakian sugar lying in the port of Hamburg was eagerly sought for, but at this moment there is not much ready sugar in Europe. The sugar-exporting European countries have already disposed of their surplusses and it is not very obvious how Germany is going to purchase sugar from her neighbours. Java is too far off to get the sugar here before the beginning of the new European crop, when the duty might be levied again. Cuban raws are not fit to be refined in German refineries, and therefore it will be chiefly American refined which will come to the rescue.

As the price of foreign sugar is rather high and will become higher still, if the demand increases, it is very probable that the German sugar users, who have to import, will do so with the greatest abstemiousness, and will prefer to sell out their stocks of sugared articles rather than buy much sugar from outside. We therefore believe that the total importation of sugar into Germany till the sugar from the 1922-23 crop becomes available, will not exceed 100,000 tons, notwithstanding the great scarcity existing at the moment.

Mr. Frank Munsey, the owner of the *New York Herald*, in the course of an interview with the London *Times*, stated that in a broad sense the wage scale in America remains pretty nearly at the high point of the war period. This high wage so expresses itself in cost of production of exportable goods that America is practically shut out from foreign trade. Considered industrially, America can have no hope of competing in foreign trade with foreign nations until such time as she gets her cost of production down to a competitive basis, and this can never be till the wage scale returns to something like the pre-war wage.

The Classification of Sugar Cane Varieties.[1]

This paper is a serious attempt to lay the foundations for a modern and up to date classification of canes. In a recent issue[2] we dealt with the introductory paragraphs, on deterioration of cane varieties, bud selection, flowering of the cane, ripening, and the spoiling of the cane juice after cutting, but left out those on the soils of Porto Rico, the history of cane introduction into the island and long ratooning, as rather of local than of general interest. In the present note we propose to confine ourselves to Earle's main thesis, the botanical study of the cane as laid out by him.

In the *Species Plantarum*, published in 1753, Linnaeus included two forms under Saccharum, *S. officinarum*, founded on thick-stemmed tropical canes and *S. spicatum*, a wild grass; but the latter, not being a true Saccharum has been excluded by modern authors. Earle traces the rapid addition of supposed species by subsequent authors, till, in 1833, Kunth in his *Enumeratio Plantarum* lists 22 forms besides varieties, while Roxburgh in his *Flora Indica* gives 11 as occurring in India alone. Later critical revision, however, again reduced the numbers, till in 1887 Hackel in his monumental revision of the grasses in Engler and Prantl's *Pflanzen Familien* recognizes 12 species of Saccharum, while Hooker in the *Flora of British India* (1897) gives only 5 as indigenous in that country. Both of these authors separate the genus into groups, in the first of which, Eu-Saccharum or true sugar canes, are placed *S. officinarum* and *S. spontaneum*.

After this summary, Earle concentrates his attention on these two species. He quotes Barber (1915) as demonstrating the great variability of *S. spontaneum* in India and its close connexion with the various groups of indigenous canes of north India, and attributes to that author the idea "clearly indicated if not openly advocated" that all cultivated sugar canes, whether thick stalked (tropical) or thin stemmed (Indian), are really descendents of this wild form. It may be permitted to the writer of this note to point out that Barber, in subsequent papers not apparently seen by Earle, was not successful in his attempt at tracing a clear line of succession from *S. spontaneum*, through the primitive Indian canes, to the thick-stemmed canes of tropical countries, and finally came to the conclusion that the evidence appeared to him rather to point to two separate lines of descent of cultivated sugar canes, the Indian canes, on the one hand, arising in India from an ancestor similar to, if not identical, with *S. spontaneum*, while the tropical forms, on the other hand, appear to have had a separate origin in the islands of Polynesia from a closely applied species now probably extinct.[3] This question of the origin of the thick and thin-stemmed cultivated canes, which differ markedly in certain respects, cannot, however, be considered as closed, at any rate until a detailed scientific study has been made of the large collections of cane arrows known to exist (e.g., the mass of material collected at Coimbatore). Such a study is highly desirable, as the results would be founded on a true botanical basis, and might throw important light on the matter.

After tracing the variations in the number of species recognized by the chief botanical authorities at different periods and the chief differences between *S. spontaneum* and *S. officinarum*, Earle turns to recent advances in the description of canes, and singles out the work of Barber in India, dealing chiefly with Indian forms, and Jeswiet in Java, whose material was mostly of tropical kinds. He considers that the work of these two authors "has laid a broad and secure foundation for the study of sugar cane taxonomy" adding that in his opinion "for the first time we have descriptions of cane varieties that are sufficiently full to permit of sure identification." Of the two he selects the work of the former as better fitted for his purpose and "more nearly conforming to ordinary botanical usage," pointing out JESWIET's remarkable method of "dividing the parts of the bud and other regions of the plant body into serially numbered areas for purposes of description, especially for noting the presence or absence of plant hairs, seems to introduce an unnecessary complication" although "followed in this by FAWCETT of the Argentine Sugar Station, who has recently published some most useful cane descriptions." He accordingly, in the detailed descriptions of the Porto Rico canes, follows "as closely as may be the terminology of BARBER in the hope of standardizing cane descriptions," although expressing a doubt as to the usefulness of the detailed measurements of the length and diameter of different parts "since these factors are so greatly altered by conditions of growth and environment." As will, however, be seen below the use of these characters is inevitable.

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[1] "Sugar Cane Varieties of Porto Rico," II. F. S. Earle. *The Journal of the Department of Agriculture of Porto Rico*, Vol. V, No. 3, July, 1921, (issued 1922). [2] *I.S.J.*, 1922, pp. 236–239. [3] *I.S.J.*, 1920, pp. 249–251.

The following is a summary of the points selected by EARLE as of special importance in describing different varieties of cane :—

1. *General habit.*—Whether the plant is erect or soon prostrate, stooling lightly or heavily, general vigour and propensity to arrow.

2. *The stalk as a whole.*—Average diameter, colour and bloom.

3. *The character of the internode.*—Comparative length, general form, the presence or absence of the groove and its character when present.

4. *The node.*—Whether this is constricted, even or prominently enlarged, and whether it is placed at right angles or obliquely to the length of the stalk. Under the node should be considered the characters of the growth ring, root band, leaf scar and glaucous band (bloom band).

5. *The bud.*—This gives characters of greater taxonomic importance than any other part of the cane, although it must be recognized that the bud varies at different ages and stages of development and judgment and experience are required in the selection of typical ones. Under this heading EARLE notes the form of the bud, its apex, the flat sterile margin, the point of germination (where the new shoot appears), the average size especially in relation to the other elements of the node, and the presence or absence of hairs, especially at the base, on the sides and at the apex.

6. *The leaf sheath.*—The presence or absence of sharp, stiff hairs over the surface and their relative persistence, the occurrence of wax or bloom, and the general tone of colour. In the leaf sheath, the throat, collar, ligule and the ligular process or processes should be noted.

7. *The leaf blade.*—Its general position, whether spreading, strictly erect or erect with declined tip: the colour, measurements, character of the serrations on the margin, and the hairs or cilia near the base.

8. *The inflorescence.*—A full description should include the arrow, but these have not been studied for the Porto Rico varieties described in the paper, being only in a suitable condition for a very brief period and, in many cases, seldom or never being produced. For practical purposes it seems best to ignore the characters afforded by them, although taking note of the tendency or the reverse to free arrowing.

In the list of cane varieties recorded for Porto Rico, covering 91 pages, all the information which EARLE has been able to accumulate during his studies is set forth under each variety. This information covers a very wide range and includes its source or origin, occurrence in the island, value agriculturally, vigour and comparative susceptibility to various pests and diseases, synonymy, chemical constitution, adaptability to various conditions, tonnage, ratooning power and so forth. A detailed description is given in simple botanical language, on the lines noted above. As an example of the latter, we have chosen Cristalina (White Transparent or Light Cheribon) as perhaps the most widely distributed and useful variety, as the author puts it "as indicated by long experience, not only in Porto Rico but in all parts of the world, this is one of the best varieties for general planting and one of the very few on which it is safe to base the entire sugar industry of any region." The following is his description of it:—

"Erect, then declined, vigorous, a good stooler, arrows freely at some times and on some soils, under other conditions it seldom arrows. Stalks medium diameter, green, usually with a strong pink flush, bloom heavy. Internodes medium length, cylindrical or somewhat tumid, straight or slightly staggered, furrow evident, of medium depth. Nodes oblique, constricted; growth ring yellowish green, conspicuous, elevated; root band narrow, oblique, slightly constricted, rudimentary roots small, inconspicuous, pallid with brownish centres, in about three rows; leaf scar glabrous, wide in front, adpressed behind; glaucous band constricted, rather narrow, not very conspicuous, blending with the bloom of the internode. Buds medium size, triangular-ovate with rounded base, exceeding the growth ring, margin wide, strongly shouldered below, germination apical, base and apex adpressed ciliate. Leaf sheaths glabrous, greenish, quite glaucous; throat densely lanate and with abundant long coarse hairs; collar conspicuous, reaching the midrib, lanate throughout; ligule medium width, margin even; ligular processes usually only one developed. Leaves abundant, spreading, flat, medium length and width, about 7 cm., bright green, minutely serrulate, the margins at base ciliate for two or three inches."

After the conclusion of the description of the varieties grown in Porto Rico, lists are given of those kinds which, from the present state of knowledge, are considered as the best for general planting, for moist well drained alluvial soils and semi-poyals (semi-marshes), compact poorly drained maritime soils and clay alluvium, red hill lands, lands with lime sub-soil, and salty lands. Also lists of very early maturing canes, canes to hold over for long crop, and canes to plant in districts infected with mosaic.

Then follows one of the most ambitious features of this important paper, namely, a key founded on the botanical descriptions already given, by means of which it is comparatively easy for those accustomed to such work to run down a cane and give it its correct name. As far as we are aware, the author has been the first to attempt this with the sugar cane varieties of a tract which have been adequately described; he published a tentative key in the first paper of this series of three,[1] but as this was before he had seen the later morphological work on which the present descriptions are founded, the key has been recast in his present paper. This is a notable botanical achievement as regards the classification of sugar canes, and brings it into line at last with the botanical work on other crops which have received a thorough scientific study. For those unaccustomed to use a key, the author gives a series of useful hints.

From the foregoing we conclude that, right or wrong in matters of detail, the intrinsic importance of EARLE's contribution towards the difficult and intricate problem of the classification of sugar cane varieties lies in the following:—

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[1] "Sugar Cane Varieties in Porto Rico." *The Journal of the Department of Agriculture of Porto Rico*, Vol. III, No. 2, April, 1919.

(1) A thorough and up to date study has been made of the multitude of cane varieties collected in one tract. (2) A careful analysis of the synonymy of these as compared with the canes grown in other countries often under different names has been made wherever possible. (3) A well chosen selection is offered from recent morphological work of those botanical characters which appear to him to be of taxonomic importance and of easy recognition in the field, and on these a useful botanical description is based which has been compressed into a moderate space. (4) An analytical key has been prepared, in which some of the leading distinguishing characters are emphasized, and by which varieties can be named and then checked with detailed botanical descriptions.

It is however to be noted that the author by no means claims that this is the final word in the matter. He offers his work as a sample which may be useful to workers in other tracts, in which of course the material to be dealt with will differ in many respects. In such studies, as new forms come under review, there are certain to be local changes in the relative value of distinguishing characters; for botanical features which are stable under one set of conditions and in one country have been proved to be less so, at any rate at first, when transferred elsewhere. This was the case with canes grown for a century in south India, where they exhibited a strictly limited range of coloration, but when taken 1500 miles north developed new shades; and similar facts have been noted in richness of juice and vigour of growth, which in certain introduced forms deviated considerably from the normal for the first four or five years after change of locality, and then gradually assumed their usual values in these respects. The leading idea is thus *the intensive study of the canes existing in a definite tract* and thoroughly acclimatized in it. The greatest obstacle hitherto existing to the evolution of a system of classification of sugar cane varieties has been the feeling that larger and larger collections of varieties grown elsewhere were necessary before such work could be commenced. EARLE has shown that this is no valid reason against such work being undertaken. This is a great step in advance, and the way is now open for a botanist in any tract to examine his local material and publish a synopsis of the cane varieties grown there. We need not await the accumulation of vast collections of canes derived from all over the world before starting descriptive work; and it seems to the writer, from the facts mentioned above regarding the instability of newly introduced forms, that a better result is likely to be obtained by a series of isolated surveys of thoroughly established forms. Such local studies of the material at hand have the advantage of proving immediately useful to the planters of the tract, and the new forms arriving can be readily worked in as soon as they have become acclimatized and have proved worthy of consideration. A complete classification of the world's sugar canes is at present unobtainable but, with a gradually increasing number of such individual surveys, should not be impossible to the well trained systematic botanist of the future.

C. A. B.

The British Engineers Association has been entrusted with the task of organizing and allotting space in the Shipbuilding, Marine, Mechanical and General Engineering Section of the British Empire Exhibition to be held in London in 1924. A form of provisional application for space is now available and copies may be had on application to the Secretary, The British Engineers Association, 32, Victoria Street, London, S.W. 1. It is pointed out that no exhibition of such scope and importance has been held during the lifetime of the present generation. The industrial development of the British Empire is an urgent economic necessity and the one great hope for the future of our race. The projected exhibition will therefore be a great national event of which full advantage should be taken by the manufacturing industries of this country.

Indian News.

Rather more than two years ago sugar interests all over the world were greatly interested to learn that the great Indian house of Tata had floated a company, called the Sugar Corporation of India, Ltd., to engage in the manufacture of sugar by modern methods in all parts of the Indian Empire.

A very strong board of directors comprising many of the best known Indian financiers, and including both European and Indian representatives, was organized. The authorized capital of this venture was five crores[1] of rupees of which one and a half crores (20 per cent. paid up) was issued.

We are now surprised to learn that this undertaking, from which so much was expected, has gone into voluntary liquidation.

To the outsider this change of attitude is hard to understand, especially after the duty on sugar imported into India has been increased to 25 per cent. *ad valorem*. This is in itself a substantial protection, and when it is also remembered that all the imported sugar consumed in the interior of India has to bear in addition the cost of ocean and railway freight, it would have been thought that a great opportunity for the investment of capital in sugar enterprises in India had arisen, more especially as a permanent market is assured, the import of white sugar into India varying year in year out from 300,000 to 800,000 tons. We presume the Tata interests in India, established as they have been for two generations, are sound judges of what enterprises are likely or not to succeed, and we are informed that the chief reason for the abandonment of this undertaking is the heavy liability on the shares issued combined with the financial stringency now prevailing in India, caused by the inflation of the rupee in 1920 (to a maximum of 2s. 10½d.) and its subsequent rapid fall to a minimum of 1s 2⅞d. Other reasons given as contributing to the change of policy are the political unrest at present prevailing in India and the difficulty of acquiring land in blocks of sufficient area to engage in modern methods of cultivation.

Of the money actually paid in (30 lakhs[2]), over 80 per cent. will be returned to subscribers, and of the balance 4½ lakhs remain with the Tata Industrial Bank as underwriting commission.

On the other hand, we are glad to learn that substantial progress has been made with the Nira Valley Sugar Co., floated by Lalubhai Samuldas of Bombay. This factory, located at Baramati about one hundred miles south-east of Poona, lies in the centre of a district where 30,000 acres of irrigated Pundhia cane are grown annually, all of which is at present converted into gur. We understand that this factory will depend mainly on cane purchased on a sliding scale dependent on the local market rate of gur, but as the capacity of the factory is only 400 tons of cane per day, there should be no difficulty in obtaining an ample supply of raw material.

The factory which has been built by Messrs. George Fletcher & Co., Ltd., of Derby, will be ready to operate in December of this year. It is thoroughly up to date in its design. It will have a 14-roller mill and quadruple effect evaporator laid out for separation of steam to both heaters and pans. Sulphitation of juice and syrup will be employed, and the latter will be filtered before being sent to the pans. Plant for double curing of the massecuites has been installed and one grade of white sugar or first and second and third grade may be turned out at will.

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[1] One crore = £666,666 13s. 4d. with the rupee at 1s. 4d.

[2] One lakh = 100,000 rupees.

Indian News.

We are sorry to learn that failure has attended the attempt made by **Sir Abdul Jamal** to introduce a modern sugar industry into Burma. In 1920 this pioneer of Burma industry obtained from Messrs. Blair Campbell & McLean two factories, each with a capacity of 400 tons of cane per day and, we are informed, costing in all over £300,000. Of these factories one has been erected ten miles north of Mandalay, but as very little cane has been planted the machinery has remained idle. The second factory remains in its original cases. Both of these factories are for sale unless they have already been disposed of since this information came to hand.

The Secretary of the Sugar Bureau at Pusa issues the following note on the production of refined sugar in India during the year 1921 :—

"In India there are at present 18 factories refining raw sugar, gur or rab. Four of these are situated in the province of Bihar and Orissa, eight in the United Provinces, four in Madras, one in Mysore, and one in Bengal. Enquiries were instituted by the Sugar Bureau to ascertain the quantity of gur and raw sugar melted, sugar made, and molasses turned out by each of these factories during the working seasons of 1920 and 1921. Returns from all factories except three were received for the season 1920 while only one factory failed to submit a return for the season 1921.

"We give below the total figures of gur and raw sugar melted, sugar made, and molasses turned out by these factories.

	Year 1920. Maunds.*		Year 1921. Maunds.
Gur and raw sugar melted	2,212,817	....	2,471,026
Sugar made	1,211,274	....	1,324,646
Molasses obtained	723,965	....	870,704

"The figures for the season 1921 are higher largely owing to the fact that two factories commenced refining gur for the first time and returns were received from two factories which did not furnish similar information for the previous season.

"A study of the returns submitted by individual factories shows that there is a wide variation in the percentage of recovery of sugar from the raw material dealt with. In Northern India where the refining jaggery is of an inferior value, the recovery of sugar varies from 35 to 45 per cent., according to the efficiency of the factory. In Southern India where the quality of gur melted is superior, better results are obtained. It follows, therefore, that in Northern India the percentage of molasses turned out is comparatively higher.

"The largest number of refineries is in the United Provinces; yet the Madras Presidency produces the largest amount of sugar refined from gur or jaggery. The United Provinces only produced 350,320 and 458,417 maunds in the seasons 1920 and 1921 respectively, as against the outturn of 410,109 and 481,448 maunds in the Madras Presidency.

"A note published by the Secretary of the Sugar Bureau in the *Indian Trade Journal* dated the 1st December, 1921, gives the total quantity of sugar and molasses produced by factories making sugar direct from cane for the year 1919-20 and 1920-21 as follows :—

Year.	Sugar made. Maunds.		Molasses. Maunds.
1920-21	669,291	....	404,712
1919-20	628,920	....	370,953

"If the quantity of sugar as refined in the country is added to these figures, the total refined sugar production would amount to 1,993,937* maunds or 73,113 tons in the season 1920-21, as compared with the total production of 1,840,194† maunds or 67,476 tons in the previous season.

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* 1 Maund = 82 2/7 lbs. or roughly ¾ cwt.

† Includes some raw sugar imported from abroad and refined locally.

"According to the published accounts relating to the Sea-Borne Trade and Navigation of British India for March, 1922, the total imports of sugar into India during the twelve months 1st April to 31st March, 1922, amounted to 717,612 tons against 236,208 tons in 1920-21 and 408,723 tons in the year 1919-20. Out of these 32,621 tons were re-exported in 1921-22 as against 72,577 tons in 1920-21 and 68,212 tons in the preceding year 1919-20. Thus India's net imports were:—

YEAR.	TONS.	VALUE.	
1921-22	684,991	250,744,032	Rupees.
1920-21	164,331	108,186,330	"
1919-20	340,611	182,672,006	"

"Of the exporting countries Java stands first as she supplied India with no less than 627,965 tons during the year just ended, the next in order of importance was Mauritius with 61,611 tons, and the third, though at a respectable distance, was Belgium with 12,798 tons.

"The effect of a comparatively low price is clearly visible in the greatly increased imports during the year 1921-22 when sugar was cheaper as compared with the previous year."

Java.

Review of Sugar Trade.

The British commercial agent for the Netherlands East Indies has forwarded to the Department of Overseas Trade a review of the sugar trade of Java up to March, 1922, in which it is stated that the total production of Java sugar for 1921 was estimated at 26,900,000 piculs.[1] Reliable figures are now, however, available for last year's production, which may be accepted as follows:—

	PICULS.	
By the V.J.P. (United Java Sugar Producers):—		
S.H.S.	13,415,000	
S.S.S.	296,238	
16/h	6,345,500	
Muscovados	3,735,100	
		23,791,838 piculs
By factories not associated with V.J.P.:—		
S.H.S.	1,055,466	
S.S.S.	38,716	
16/h	1,420,707	
Muscovados	437,822	
		2,952,711 piculs
Total		26,744,549 piculs

Up to the end of December the total shipments amounted to 21,921,000 piculs. Taking the local consumption at the estimated figures of 100,000 piculs a month, it was generally supposed that there remained in Java approximately 4,000,000 piculs of the 1921 production on the 1st January, 1922. Later events have proved that the remaining stock had been over-estimated, probably due to excess local consumption.

Exports in January totalled 1,600,000 piculs, and it soon became evident that there was a shortage of old crop, and consequently the price of Superior rose steadily until the middle of February, when the highest point, namely, f. 19·50 per picul, was reached, while Channel was sold at f. 15·25.

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[1] One long ton = 16·45 piculs.

These prices were higher than those ruling in foreign countries, and exporters tried to cancel contracts or re-buy sugar already shipped and sold in order to fulfil contracts; in fact, Java sugar was re-imported from British India, Japan, Port Said, Constantinople, and even from Holland.

The exports in February fell to 637,000 piculs, the smallest monthly export recorded during the past seven years.

The situation was relieved by the V.J.P. obtaining and disposing of the old stock held by the liquidators of the Java Overseas Company, and at the end of March the price for old stock Superior had dropped to f. 14·00 per picul for small quantities, at which prices there were more sellers than buyers.

The total exports of 1921 crop to the end of March were 24,400,000 piculs, and little of this crop now remains for shipment.

The 1922 production.—In January the V.J.P. fixed the lowest prices they would accept for 1922 sugar at:—

	PER PICUL.
S.H.S.	f. 11·00
16/h	f. 10·00
Muscovados	f. 9·75

An attempt by exporters to make the V.J.P. reduce these prices failed, and consequently for the first two weeks of the year little buying was done. An improvement in Cuban prices early in January created local interest in the 1922 crop, and important quantities were sold forward by the Association, prices also slowly improved, and at the end of March touched f. 12·00 per picul for S.H.S.

This improvement is, however, not attributed to an improvement in prices in foreign markets, but is owing to the Association refusing lower prices in order to create a better demand for Browns, for which there were few enquiries at the fixed minimum price.

The total sales to 31st March, 1922, were as follows:—

S.H.S.	7,408,477	piculs.
S.S.S.	281,110	,,
16/h	1,450,200	,,
Muscovados	2,738,961	,,
Total..	11,873,748	piculs.

It is possible that the whole of the 1922 crop will be sold out before the 1923 crop is available, and that prices obtained will average out a little better than the minimum prices fixed by the Association. It also seems fairly evident that the present economic situation in British India will affect the sugar trade between Java and that country.

The total exports of Sugar in metric tons for the first three months of the year are given as 125,081 against 189,726 in the corresponding period of 1921.

The exports to British India during the same period were:—

	1921.	1922.
Bombay	13,145	355
Karachi	15,239	2,861
Madras	716	nil.
Calcutta	19,682	8,546
Rangoon..	3,721	3,661
Colombo	1,970	1,492
Other British Indian Ports ..	1,234	16
Total	55,707	16,931 Metric Tons.

A Case of Damaged Java White Sugar.

By CHARLES MÜLLER,
Consulting Chemist, Alexandria, Egypt.

A local dealer sold to another by contract two lots, each of 30 tons, of Java white crystallized "superior quality" sugar in transit. These sugars were shipped from Hong-Kong, and when the two lots arrived at Port Said by the same boat they were examined superficially by the buyer, who, seeing that the second lot was damaged, refused the merchandize.

The two parties decided to have recourse to a report, and an expert was appointed for this purpose. After examining the sugar and taking samples in sealed bottles (of which two were retained by both parties to allow of an eventual second opinion), the expert presented his report, in which it was concluded that the second lot should be refused since it did not correspond to the stipulations of the sale contract, the reasons for this refusal being as follows:—

1. There was no moistening by sea water; but the sugar had an inherent defect (*vice caché*) consisting in the presence of traces of sulphuric acid, which had caused a strong diminution of the polarization with augmentation of the glucose. 2. Since the polarization was lower than 99·30°, the product was no longer of the "superior quality" specified in the contract, but was second jet sugar. 3. The greasy appearance of the sugar was caused by its apparent humidity due to insufficient refining, causing it though white and crystallized to be classed as a very inferior product.

In brief, according to this expert, the buyer was quite within his right in refusing the merchandize, the damage proved being due to the actual nature of the goods, which were of inferior quality, and not from causes arising during the transport.

However, the buyer did not accept this opinion; and demanded a further report on the question, which was entrusted to the writer.

Since the goods had been sold some time ago by public auction, and only the sealed samples remained, the case was rather embarrassing. For example, without an examination of the bags it was impossible to come to conclusions regarding the nature of the alleged humidity by the first expert. Was this humidity (wetting by sea water being excluded) the result of imperfect turbinage, of an absorption of steam in the hold of the ship, of rain during the voyage; or might not it be attributed to the infiltration of water through the floor of the store?

Nevertheless, the bottles were opened, and the samples were analysed by the well-known official method. Thus, the sucrose was determined with a Schmidt and Haensch saccharimeter, sensitive to 0·05°; and the reducing sugars by Pellet's method, heating to about 65°C. with the Fehling's solution, weighing the Cu_2O on a tared filter, calcination to CuO, and weighing as such. Further, the sulphurous acid was determined by standard iodine, while the sulphuric acid was also quantitatively ascertained.

On opening the bottles, it was found that the first sugar looked dry, having, in fact, the appearance of a white sugar of excellent quality, the crystals being regular and brilliant, which is usual with Java sugars manufactured in irreproachable fashion. The reaction was distinctly acid.

Sample No. 2 presented a different aspect. The excess of humidity was clearly visible, but it contained no hard and yellowish lumps indicating imperfect turbinage. The rather dull crystals did not adhere together, but the sugar appeared greasy, as had very advisedly been remarked by the first expert.

	First Sample.	Second Sample.
Sucrose	99·45	97·80
Reducing sugars	0·15	0·37
Ash	0·15	0·14
Organic matter	0·14	0·22
Moisture	0·11	1·47
	100·00	100·00
Ratio: Organic matter to ash	0·93	1·23
Rendement	98·55	96·50
SO_2 grms. per kg.	0·018	0·020
SO_3 ,, ,,	nil	traces
Matter precipitated by absolute alcohol	nil	considerable

It is seen first of all from these analyses that No. 1 indicates a sugar of excellent quality without any deterioration. On the other hand, No. 2 shows a notable increase in the moisture, the reducing sugars, and the undetermined organic matter, which seemed to be caused by a transformation of the sucrose. Indeed if one calculate the excess reducing sugars into sucrose, and if this latter constituent be calculated on the moisture basis of the second sample (which is about the average for such sugars) the sucrose content then becomes 99·36 instead of 99·45 per cent.

Regarding the sulphurous acid, it is about the same in both analyses; but No. 2 shows traces of free sulphuric acid, the probable cause of inversion; while the solution of this sugar treated by absolute alcohol gave a white and rather abundant precipitate.

It is certain that the action of the humidity and of heat had as its effect the alteration of this second sugar. This moisture had been acquired during transport, since if it was to be attributed to an imperfect turbinage the sugar would have contained yellowish lumps, and would be tacky, which it was not. This excess of moisture had provoked the partial oxidation of the sulphurous acid existing in the sugar, whence inversion and loss of polarization. It follows therefore that there was no *vice caché*, of which the first expert spoke, since the other sample containing about the same quantity of sugar remained sound during the voyage.

Having discussed these points, here are our conclusions, which the two parties finally accepted: 1. The first sugar is absolutely normal. 2. The second has undergone a notable loss of polarization, due solely to the moisture acquired in the course of the voyage, and not at all to a *vice caché*, which had no existence. These sugars were not refined. 3. The term "superior quality" had no precise meaning, the degree of polarization or the minimum commercial rendement not having been specified in the contract. As the sugar was described as white and crystallized, it conforms with the stipulations of the document.

A further question arises. The presence of matters precipitable by alcohol would indicate the formation of dextrans, due to the action of micro-organisms similar to *Leuconostoc* as studied by Noël Deerr in Hawaii. In this case the antiseptic action of the sulphurous acid had not been sufficient to hinder the decomposition.

Recent Work in Cane Agriculture.

GERMINATION AND PRESERVATION OF SUGAR CANE POLLEN. *T. S. Venkataraman. Agricultural Journal of India. Vol. XVII, Part II, March, 1922.*

This short paper summarizes the chief results obtained by the author during the past six years on the viability of sugar cane pollen, with especial reference to the possibility of preserving it so that crosses may be obtained between canes not flowering at the same time and place.

Germination.—Viability is of first importance, and for this to be studied a suitable medium for the germination of the pollen must be found. The iodine method of determining healthy pollen does not apply because, although the presence of starch shows that the pollen is healthy, this starch remains after viability is lost. Pollen germination is difficult in the sugar cane, as all the current media appear to be unsuitable. It is perfectly feasible on sugar cane stigmas, but this method has two objections, namely, that stray foreign pollen is always floating in the air, and when the tubes are protruded they can with difficulty be seen among the mass of brightly covered stigmatic hairs. In these circumstances the stigmas of surrounding weeds, bushes, and trees were tried as media; and as many as 60 species were called into requisition, with the result that the following were selected as giving good results:—*Datura fastuosa var alba, Carica Papaya, Hibiscus vitifolia, Gynandropsis pentaphylla* and *Thespesia populnea.* Of these the first-named was eventually chosen, because the germination was most satisfactory, the large flowers are easy to emasculate, it is always abundant in or near the cane fields, the stigmas are receptive long before the anthers open, the stigmatic surface remains receptive for a considerable period, and stray pollen of the plant is very readily separable from that of the sugar cane. The method adopted is as follows:—The Datura buds about to open are cut and placed in water, then gently opened, and the large stamens pulled out by tweezers. Sugar cane pollen to be tested is dusted on and tested in an hour and a half by scraping off a small portion and examining it under the microscope in water; if viable, numbers of the pollen grains show the protusion of their tubes, distinct nuclei often being visible.

Preservation.—This was a more difficult problem. In the open air the pollen appears to decline in viability in about 20 minutes and loses it altogether in half an hour. The main aim at the station is to obtain crosses between the hardy north Indian canes and the richer tropical ones, and the latter as a whole usually flower from 15 to 20 days earlier. The first attempts were to prolong the life of the pollen by keeping it in a moist atmosphere, but this only succeeded up to about three hours, and, by preventing the protruded anthers from opening, for as long as six to eight hours. Then it occurred to the author to prolong the life of the arrow and inhibit the protrusion of the stamens by cutting off about a foot of cane attached to it, and this was far more successful, ultimately delaying anthesis for as long as 11 days. The following was the *modus operandi*:—Cut the arrow well before the usual hour of protrusion of the anthers with a foot of cane attached, place this immediately in a bucket of water making a fresh cut beneath the water, and remove to a shady place; then fix the cut end in a ball of wet clay. The arrow thus prepared is wrapped first in tissue and then in brown paper, and placed in a specially constructed bamboo crate, triangular in section and about 1 ft. in width on each of its three sides. The whole crate is wrapped in loose trash or straw and is sprinkled with water to keep up a moist atmosphere, and the arrows are securely fastened to the sides to prevent movement. Thus prepared the arrows remain healthy, and the anthers may remain dormant for a number of days. After removal of the paper wrappers, again placing in water and removing a thin slice at the base of the cane, the anthers will emerge and open in a still warm room much as in the field. Experiment showed that it was perfectly feasible to send arrows in this way to a distance. A test case included a railway journey of 250 miles during a whole night, and a ten-mile journey in the hot sun by road for ten miles occupying four hours. By this means arrows can be transferred from one station to another where the desired female parent may be in flower.

Review of Agricultural Operations in India, 1920-21. *Superintendent of of Government Printing, Calcutta, 1922. Sugar Cane, pp. 9-14.*

One of the main features of the year's work on sugar cane was the promising results attending the trials of new Coimbatore seedlings, more especially those obtained by crossing thick canes with *Saccharum spontaneum*, a natural grass known as kans or rahri. Hybrids possessing the deep-rooting character of this wild grass and the sucrose content of the sugar cane have proved remarkably suitable to North Bihar and parts of the Punjab. At least one hybrid has appeared with the additional quality of early ripening, which will supply a long-felt want of the cane growers and factories in Bihar, and arrangements are being made for the rapid multiplication of this hybrid.

In the United Provinces, where over half the total area under sugar cane in British India is situated, the local Agricultural Department has a wide range of varieties for distribution. M 16 and J 247 have proved suitable for intensive cultivation and, among local selections, S 48 and S 10[*] have been shown to resist several degrees of frost in other parts of the world; Coimbatore seedlings have shown remarkable vigour, although not quite up to the best indigenous varieties in sucrose content. In Madras five new seedlings were finally approved during the year as suitable for trial in North India, bringing the total of those being tested there up to 38. The dwarf Mungo class which had not previously flowered did so freely on the Coimbatore farm for the first time. New methods of preserving pollen and extending the period of viability were evolved, as mentioned elsewhere in this number of the Journal. In Bihar, where the bulk of India's sugar is made, J 247 has sufficiently proved its superiority to justify extended distribution. It is hoped that eventually about six varieties of nearly equal gur content will be evolved, ripening successively from December to March and thus enabling the ryot to extend his harvesting period, a matter of great importance to the factories.

In Bengal Yellow Tanna continued to hold its position as best suited to the varying conditions of the presidency, while in the Punjab Saretha was best in the Canal Colonies, and Bihar and Co 205 headed the list at Gurdaspur farm. In Assam the varieties found most suited for distribution were Striped Mauritius, B 147, B 376, and J 33A, while of new varieties Co 9 and D 74 were the most promising, averaging 10,024 lbs. of gur per acre. In the Central Provinces Khari maintained its position as the best variety to replace the local Katai and Kala and some of the Coimbatore seedlings were very promising. The experiment at Tharsa farm on irrigation, which has been conducted continuously since 1915 has given the optimum quantity of water required for sugar cane per acre as 100,000 cub. ft. delivered in 29 waterings during the year. In Bombay considerable success has been obtained in reducing the cost of manuring, and cane cultivation is rapidly extending in Burma where the local Agricultural Department is no longer able to supply the seed demanded, the following varieties, introduced from Coimbatore, being apparently the most successful:—Ashy Mauritius, B 147, J 247 and Gilman. There is the prospect of white sugar factories being opened in the Insein, Mandalay and Myitkina districts and a jaggery factory has been opened during the year at Hopin. Lastly, in Mysore seedling work is being continued and at least two seedlings are mentioned as superior to Red Mauritius, which exceeds the local standard cane, Pattapatti, by 25 per cent. in outturn.

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[*] The letter S does not, as usual, refer to seedlings raised at the Shahjahanpur Station, but merely cane varieties collected either from the neighbourhood or other parts of the world and experimented with. Although this unusual procedure may have its advantages from a certain point of view, hiding the identity of cane varieties is of doubtful general utility and may lead to a good deal of confusion.

THE WHITE-GRUBS INJURING SUGAR CANE IN PORTO RICO. II. THE RHINOCEROS BEETLES. *E. Graywood Smyth. The Journal of the Department of Agriculture of Porto Rico. Vol. IV, No. 2. April, 1920.*

White grub may include the larvae of any of the large Scarabaeid beetles of the Lamellicorn family, which is divided into two tribes, the Melolonthini and the Dynastini. The habits and life history of the members of the former found in Porto Rico were described in the *Porto Rico Journal*, Vol. I, Nos. 2 and 3 and concern four species of Phyllophaga and one of Phytalus. The present paper deals with two of the much larger beetles of the Strategus genus, generally known as the sugar cane and the coconut rhinoceros beetles from their prevailing food plant. These beetles seem to be changing their habits. Their formidable grubs usually live on decayed wood and it is only in the tropics that they have been reported as plant pests. This appears to be due to the gradual destruction of the forests there and a striking case in confirmation of this is afforded by an island adjoining Porto Rico. Here the forest has almost entirely gone and the attacks on sugar cane are of a severer type than in Porto Rico. The enormous voracity of the larvae enables a small number to do a great deal of damage and their change of habit makes it desirable to keep them steadily in view.

Strategus quadrifoveatus is a well known coconut pest and rarely attacks sugar cane, as the grubs have not as yet acquired this habit. The beetles are, however, occasionally found destroying isolated stools, often half a dozen males and a single female, suggesting that they have been attracted by the latter when it is seeking a place for oviposition. Experiments show that the grubs cannot feed on sugar cane alone, and if decayed wood is not supplied they soon die. In case this form changes its habit and acquires the power of breeding on sugar cane the matter will become very serious because of its wide distribution. The case of *Strategus titanus* is different: it is a definite sugar cane pest, and sometimes does a considerable amount of damage. But even here the harm done is probably often exaggerated. This is due to the fact that the grubs do not penetrate the soil so deeply as the smaller white grubs and thus are more obvious to planters. A case is given by the author to illustrate this. In April 1913, serious injury was reported by rhinoceros beetles on an estate. An inspection showed a number of rhinoceros grubs around the roots of the injured stools, but as some of these grubs were attacked by a fungus (Metarrhizium) a second visit was paid. 48 stools were dug up to a depth of 18 ins., and the following collection was made:—16 Strategus grubs, 317 Phyllophaga and 77 Diaprepes. This gives one Strategus larva to every three stools, but seven Phyllophaga and two Diaprepes per stool. The Strategus grubs were the most obvious, but the real damage was done by the may beetle and the root weevil.

The life cycle of *Strategus titanus* is carefully worked out, the various stages described and the proportions of decayed vegetable matter required for the best development of each stage in confinement. Natural control is effected by the mongoose and a black bird, various mites, a bacterial disease and the green muscardine fungus. Accessory methods for eradication suggested are the thorough breaking up and exposing of the old stools, avoiding an excessive supply of decaying vegetable matter, the use of poisoned bait, and manure heaps as traps, the latter being opened once a month, and the grubs collected and destroyed.

TROISIÈME RAPPORT DE LA STATION AGRONOMIQUE DE LA GUADELOUPE, 1920-21. *Point-a-Pitre, 1922. Pp. 7-12, La Canne-à-Sucre.*

Returns were obtained from 13 usines and the few remaining ones estimated; on these data the canes worked during 1920 and 1921 averaged 386 million kgs. and produced 27½ million kgs. of sugar. The return was 7·19, of which the writer of the report is not proud. He also draws attention to various faults, such as the growing of five to six varieties in a single field, the high cutting of the canes in the field, and the delay in bringing the cut canes rapidly to the mill: the factories are not well arranged and there is practically no chemical control: ratoons are grown to the fourth year but in an analysis of the yields he doubts whether this is economical. There is a considerable increase in the experimental work recently begun, as is inevitable when ratoons are reaped and new seedlings and varieties are being constantly introduced. But the plots are sometimes not well attended to and, this being so, it is questionable whether any further expansion should be encouraged.

The manurial tests with ratoons show that the plot with nitrogen and potash gave the best result, with 3415 kgs. sucrose per hectare above the no manure plot, whereas in the plant canes last year that with nitrogen alone was most successful. The addition of phosphates again showed no advantage. Among the varieties, B H 10 (12) maintained its leading position at Grande Terre, with 7839 kgs. saccharose per hectare, 18·70 per cent. sucrose in the juice and 88 purity, B 67 and Ba 11569 were promising, while of the new canes Blanchet 2 and J 247 gave good tonnages: Cristalina was 12th and Big Tanna Blanche 16th. In the Table giving the average of the two seasons the first four were B H 10 (12), B 6450, B 6032 and B 147. It is recognized that a longer series of years is necessary, but meantime the first named may be fairly safely recommended.

In Guadeloupe proper B H 10 (12) again headed the list, while Big Tanna Blanche which is typical of the region was 12th and B 208, although giving the best juice, was unplaced in the list of 53 varieties experimented with. In the ratoons the first named was however only 4th, giving less sugar than three B S F seedlings. Of local seedlings, 9000 are now under observation at the Jail station. Among other experiments the addition of lime appeared to have no effect and a similar result was obtained with trashing.

C. A. B.

In view of the fact that announcements have lately appeared in the press of the projected voyage round the world of the steamer "Orontes" renamed "British Trade," it has to be pointed out that this vessel has no connexion with the British Trade Ship Ltd., whose proposal, as we outlined it in our issue of November, 1921, is to build a special ship for the purpose of an exhibition and send her round the world in 1924.

We regret to announce the death on June 1st, of Mr. ROBERT KERR, of Greenock, Scotland, at the age of 72. Mr. KERR had been Chairman and Managing Director of the Glebe Sugar Refining Co., Ltd., for many years; and by his enterprise he succeeded in face of many difficulties in developing this concern to its present position. Mr. KERR was President of the Greenock Chamber of Commerce, and of the Provident Bank, and was a prominent Unionist politician. He was also associated with several philanthropic institutions, and was a much respected figure in the life of his community.

Standard Plant Capacities for Beet Sugar Factories.[1]

Lists are given of the standard equipment for beet sugar factories compiled by the Syndicat des Fabricants de Sucre de France. Where two sets of figures are given they relate to factories of 500 and 1000 tons per day respectively; and where only one dimension is stated, it holds for both sizes of factory.

Washing department.—Hydraulic carrier; May stone separator; two washers; strainer and Lemoine herb separator; elevator (screws or wheels, according to case); washed beet elevator, with two chains; evacuation of muddy water by centrifugal pump and concentration of muddy waters in decantation tank; automatic weighing; slicing machine, with two knife-drums and Goller knives; rake or screw carrier.

Diffusion.—14 vessels of 60 and 120 hl. with heaters of 15 sq. m. (brass tubes and steel plates) with doors as large as possible, the lower 1·6 m. and the upper 1 m.; water pressure by tank or centrifugal pump; measuring tank, cylindrical with inclined bottom; Koran strainer for the juice and May strainer for the press waters; discharge of the cossettes by centrifugal pump (Felix process); four large cossette presses, Bendel-Klusemann, with perforated cones; evacuation of the pulp by Gandillon screws for short distances and rake carriers for larger ones.

Lime-kiln.—Kern type, 45 and 70 cub. m. (for hard stone); and 180 and 200 cub. m. (for soft stone); CO_2 gas washer; elevator, with automatic charging; emptying by Morgat grates with small wagon; coke breaker; Mik milk-of-lime mixer, 8 m., with automatic charging of the lime; centrifugal pump for milk-of-lime; Eisner screen; and reserve tank.

Juice liming.—Measuring tank; two heaters for the first carbonatation (with stirrers) and two for the second (also with stirrers); mixing tanks for the limed juice for 25 min. contact.

Carbonatation.—First carbonatation: Two tanks, 100 and 150 hl. actual capacity; 4 and 7 filter-presses, each having 50 plates 1 m., Massicot type, the thickness of the cakes being 30 mm.; hydraulic discharge of the scums; second filtration through 3 and 6 large open Danek (Maresch) filters of 42 sq. m. each. Second carbonatation: Two tanks similar to the first; three filter-presses having 30 plates 1 m., Massicot type; filtration through 3 and 6 large open Danek (Maresch) filters of 42 sq. m.; sulphitation, continuous using the Quarez apparatus and filtering through large Daneks (Maresch); boiling and filtration through Philippe filters of 40 sq. m.

Boilers.—100 and 200 sq. m.: (*a*) semi-tubular, Fairbairn without superheating, 10 kg. working pressure; (*b*) semi-tubular, Fairbairn super-heating 80° to a total of 250°, working pressure 8 kg.; (*c*) multi-tubular Stirling, 12 kg. working pressure, without superheating (which boilers produce 18-20 kg. of steam per sq. m. of heating surface, and 700 and 1400 sq. m. would suffice); automatic feeding and mechanical removal of the ashes, feeding pump, oil separator, and brick chimney.

Motive power.—600 and 1100 h.p., exhaust pressure 1·7 kg.; one large engine for slicing station and annexe, lighting and transport of power in triphasic, 50 periods; one gas engine operating the pumps for the circulation of the juice; one dry air pump working the evaporator services, mixers, carriers and elevators, molasses pumps, etc.,; one group of 50 and 100 h.p. Larbodière, as auxiliary, for lighting, etc. Or the following alternative: one large engine for slicing station, annexe, and juice circulation; one group for carbonic acid gas and dry air pump;

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[1] Circulaire hebdomadaire, 1921, No. 1661.

one engine working the evaporator services, the mixers, carrier and elevators, molasses pumps, lighting, and power transport. In electrified factories, 600 and 1100 h.p. used, three engines of 300 and 650 h.p. respectively.

Evaporation.—1000 and 2000 sq. m. (the diffusion juice being heated by vapour at 105°C.); quintuple effect; regulation for admission of direct vapour by steam pressure of the first body; brass tubes of 1·35 m., outside diam. 35 mm. for the first two bodies, and 30 mm. for the last three; juice circulation, Chapman system; withdrawal of the condensation waters and feeding by Michaëlis system; heaters, 16–18 circulations, speed up to 2 m., average 1·15 m. Temperatures on leaving diffusion 35 °C., before the first, 70–75°; after first, 95°; before second, 95°; before boiling, the highest; before evaporation, the highest; thick juice or syrup, 90°.

Condensation and vacuum.—Barometric condenser with cascades and counter-currents; cooler with chimney; dry air pump.

Sulphitation of the syrups.—Quarez apparatus working in the cold, with hot filtration through three Philippe filters, having 30 frames.

Boiling.—First strike using virgin syrup (thick-juice), 10–12 hours, 92-95°; second strike 15–16 hours, with pied-de-cuite of rich syrup, remelted sugar, 75-78°, 15-16 hours; third strike, rich syrup from second strike with poor syrup, 24 hours; and molasses.

Pans.—First, four of 200 and 400 hl. actual capacity; heating surface, 0·56 sq. m. per hl. of actual capacity; second, four of 200 and three of 500 hl. actual capacity.

Crystallizers.—230 hl. each; 2 and 4 for the first strike, 3 and 6 for the second, and 4 and 6 in reserve with continuous mixing.

Sulphitation of low syrups.—Heating and filtering through 2 and 4 Philippe filters of 30 frames each.

Centrifugals.—First strike, 3 and 5 of 1·06 m.; second strike, 3 and 4 of 1·06 m., third strike, 2 and 3 also of 1·06 m.; two Kreiss installations for the transport, elevation, and bagging of the sugar; two Thomas elevators. Centrifugals to be water-driven. Syrup tanks and pumps. All the circulation of the juice to be made by centrifugal pumps. Installation for drying the greater part of the exhausted cossettes, by utilizing the waste flue gases. Storage and filtration tanks to be covered with isolating material. Engines to be provided with safety devices. Gearings of crystallizers to be standardized and interchangeable.

Some Cuban Manufacturing Data.

From the sixth annual report of the Cuba Cane Sugar Corporation, for the year ended September 30th, 1921, the following figures are taken representing average data of the company's mills:—

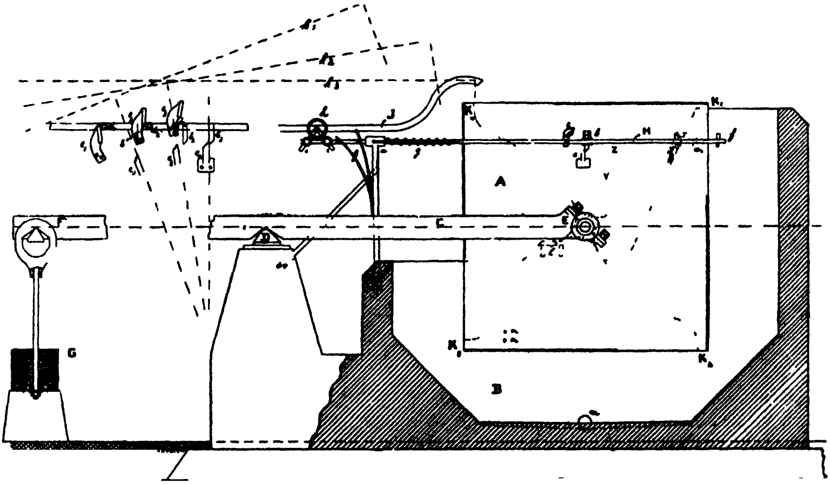
	1915-16.	1916-17.	1917-18.	1918-19.	1919-20.	1920-21.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Sucrose in the cane	13·87	13·00	13·31	13·02	12·95	12·60
Losses in manufacture	3·07	2·67	2·36	2·32	2·37	2·23
	Cents.	Cents.	Cents.	Cents.	Cents.	Cents.
Receipts per lb. of sugar	4·112	4·479	4·630	5·398	10·345	3·891
Cost of production, f.o.b., per lb. of sugar, including the colono's cane	2·748	3·431	3·998	4·606	8·523	4·355
Ditto, excluding cane	0·715	1·072	1·456	1·555	1·940	1·943

An Automatic Weighing Machine for Maceration Water.[1]

By D. ROMONDT, of Boedoeran Sugar Factory, Java.

In regard to the weighing machine described hereunder, my main purpose in view has been to construct a simple and reliable apparatus capable of being put together by any engineer in the sugar factory workshop. It is adapted only for use with clear liquids (and therefore not for raw juice), any alteration in the tare weight not being provided for.

It consists of a tank of sheet iron *A*, which is divided by partitions into four sections. Through the middle of the tank runs an axle, which is firmly connected to the tank, and which rests in two bearings, *E*. These bearings form one arm of a balance having its fulcrum at *D*, the other arm at *F* supporting a weight *G*, and it is obvious that the arm supporting the tank must be forked. Division of the tank into its four sections is effected by sheet iron, which is bent into such a form that when the uppermost section is full its centre of gravity *Z* lies to the right of the axle.



In this way the tank would tip were it not hindered from so doing by the steel blades *b* and *c* which rest against one another, the upper being fixed to a movable square bar *H*, which is supported in the two blocks *a* and *a*¹. This bar is held to the left by the spiral spring *g*, and is further restricted in its movement by two wedges *f* and *f*¹. The left end of the bar operates a cock *h* in the water supply pipe *J*. When the bar *H* is held as far as possible to the right, then the cock is open, while when it is in its extreme left position, the flow of water is shut off.

Suppose the tank to be empty in the position indicated in the drawing, and the bar *H* to be to the right as far as possible, *f*¹ resting against *a*¹, the stop-valve being opened. By means of a support under the weight *G* and another under the fork at *l*, the swingings are reduced to a few millimetres. During its filling, the tank inclines to tip, but is hindered by the steel blades *b* and *c*. When it is full, then it lowers; the steel blades disengage; the bar shoots to the left; the stop-valve closes; and the tank turns over. Through the opening K^1 the liquid discharges into the reservoir *B*, from which it is run out through the pipe *m*; but the tank is still engaged by the blades *b* and *c*, being in its old position except that the next empty section is now on top ready for filling.

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[1] *Archief*, 1922, **30**, No. 17, 289-292.

In the detailed sketch on the left of the drawing, the manner in which the bar *H* is again brought to the right is shown. Since this bar must undergo a fairly good displacement in order to open and close the stop-valve, it is not possible that the following steel blade *c* should intercept *b* and force the bar back into its original position, since then the steel blades would have to lie across one another too great a distance, quite a small overlap, e.g., 5 mm., affecting the accuracy of the weighing. Therefore to the tank is fixed a bent piece of iron *e* having on its right side a smooth surface. This protruding piece moves against the inner side of the rod, which carries a pin *d*. When the tank is in the position K^1, then the ear-shaped piece e_1 moves against the pin d_1 and pushes it back. In the position K_2 the pin has passed over the smooth surface of e_2, and is on the point of shooting it on. This would be accomplished a little later, but the steel blade c_2 is then at a sufficient height in order to catch b_2 and later assumes the final position, b_3 engaging c_3.

The effect of the friction between the points *b* and *c* should be very slight; and can be kept at the minimum by grinding the steel blades as smooth as possible, by making the overlap short, and by fixing the centre of gravity of the section when filled as close as possible to the point of support. Furthermore, the steel blade *b* can easily be made to strike a piece of well-oiled felt so that lubrication is ensured. So as to prevent a too rapid turning of the tank, and consequently injury to the steel blades, a brake should be provided; for example, by fixing to the side-wall of the tank concentric with the axle *E* an undulating brake-bank against which runs a block attached to the forked arm of the balance.

In order to learn the size of the tank for weighing the maceration water for the last mill, assume the factory has a capacity of 15,000 picols (912 tons), and that the maceration is 15 per cent. Then per day about 140 cub. metres (37,000 gallons) of water are used, or 6 cub. metres per hour. Each filling demands 2½ mins., or 10 mins. for the whole of the tank, so that six tanks can be filled per hour. A tank of 1 cub. metre is therefore necessary. If its dimensions are 1·25 × 1·25 × 0·75 m., the weighing capacity should be sufficiently great. The weight of such a tank may be estimated at 250 kg. (5 cwts.) using ⅛ in. sheet iron, or about 500 kg. with one section filled, not an excessively heavy construction. A tell-tale may be attached to the forked arm of the balance.

The new Jamaican Preferential Customs tariff which was assented to last April by the Governor of Jamaica and is now in force, introduces for the first time in that colony a general system of British preference. At present, we gather, the preference is only applicable to goods derived from the United Kingdom or Canada, but it may be extended to any other part of the British Empire by resolution of the Legislative Council. The general tariff on sugar is fixed at 8s. 4d. per 100 lbs., both raw and refined, while the preferential tariff is 6s. 3d. Sugar machinery and agricultural implements are to enter duty-free under the preferential tariff, but are dutiable at the rate of 5 per cent. *ad valorem* under the general tariff. Certificates of origin are required for all goods imported under the preference, while certificates of value will be required for imports subject to *ad valorem* duties.

The death is reported from the States of Mr. Henry T. Oxnard, one of the pioneers of the United States beet sugar industry, in which he spent practically all his life. The town of Oxnard, California, was named after him.

Insoluble Matter Content of Direct Consumption Sugars.

By J. P. OGILVIE.

Mr. GEOFFREY FAIRRIE, in one of his discourses to which we have already drawn attention,[1] stated that "high grade direct consumption sugar" (that is, Demerara and Jamaica yellow crystals, crystallized Trinidad, and plantation white sugars,) on being dissolved in water leave a "muddy sediment," an assertion which any chemist having even a slight acquaintance with such sugars would at once pronounce as extreme.

It is at any rate a statement easily put to the test, and this was done in the following manner: After mixing the sample of direct consumption sugar, 20 grms. were weighed out, dissolved in hot distilled water, and the liquid passed through a small tared filter-paper. After the filter had been well washed with water, it was replaced in the weighing bottle, and dried to constant weight in the air-oven at 105° C. (which temperature was maintained constant throughout all the determinations). Finally the filter was incinerated, in order to obtain an indication of the relative proportion of mineral and organic matter present. Here are the results obtained with several direct consumption sugars, which very fairly represent grades that may be purchased at retailers in the United Kingdom.

	SAMPLE.	Total Insoluble Matter. Mgrms. per cent	Inorganic Matter. Mgrms per cent.	Organic Matter Mgrms. per cent.
1.	Trinidad y.c., No. 1	25	7	18
2.	,, ,, No. 2	20	7	13
3.	,, ,, No. 3	10	2	8
4.	,, ,, No. 4	25	12	13
5.	Demerara ,, No. 1	48	22	26
6.	,, ,, No. 2	15	11	4
7.	West Indian p.w.	25	12	13
8.	Mauritius p.w.	15	7	8
8.	Natal p.w.	13	7	6

It is seen, therefore, that the total insoluble matter found in the West Indian yellow crystals was really very small, varying between 10 and 48 mgrms., or 0·01 and 0·05 per cent., making it difficult to understand how even a partisan like Mr. FAIRRIE could term such an amount a "muddy sediment." In the case of the plantation whites, as one would expect, the total insoluble matter was found to be less, averaging 18 mgrms., or 0·02 per cent., though it may be remarked that the three samples examined do not represent the best grades that are manufactured. A South African plantation white, which was recently examined, yielded on solution in water a liquor that was practically clear and colourless, and in appearance closely resembled the best refined.

In the manufacture of genuine yellow crystals it is well known that considerable care is taken to eliminate insoluble impurities from the syrup before boiling to grain; while in the case of plantation whites a necessary condition is that the syrup going into the pan should be quite clear. In view of this, one would expect the insoluble matter in these direct consumption sugars to be less than in raws, in the manufacture of which no special effort is taken to eliminate the impurity in question. In Cuban 96° sugars the insoluble matter, as the result of the examination of a good number of samples, was recently reported to average 60 mgrms.,[1] and in some samples to be as low as 30 mgrms. per cent.

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[1] *I.S J.*, 1922, 230, 321.

These determinations were carried out by Messrs. J. J. **Eastick & Sons**, consulting and analytical chemists, of 2, St. Dunstan's Hill, London, E.C. 3, to whom the author's best thanks are due for the results obtained.

Czecho-Slovakia and its Sugar Trade.

(American Commerce Report.)

The Republic of Czechoslovakia includes the former crown lands of the Kingdom of Bohemia—Bohemia, Moravia, and Silesia; Slovakia, the Province formerly under the crown of Hungary; and the small autonomous State of Subcarpathian Russinia. The total area of this country is 140,000 square kilometers, or about one-third the size of France, and approximately the size of the State of Illinois.

The first census of Czechoslovakia, taken on February 15th, 1921, gives 6,663,131 inhabitants for Bohemia, 2,660,653 for Moravia, and 670,585 for Silesia. The returns for Slovakia and Subcarpathian Russinia have not yet been received. The population of the whole country is estimated at 13,594,973.

Czechoslovakia produces 92 per cent. of the sugar produced in the territory formerly constituting Austria Hungary. Of the 221 sugar factories formerly belonging to Austria-Hungary, 183 are now in Czechoslovakia. During the record year of 1912–13, these 183 factories manufactured 1,574,791 metric tons of sugar, out of a total production of 1,961,625 metric tons for Austria-Hungary. This amount represents 18 per cent. of the world production of beet sugar and 8 per cent. of all kinds of sugar, thus giving Czechoslovakia second place in the production of sugar.

The average production of sugar in Bohemia, Moravia, and Silesia during pre-war years, measured in metric tons, is: Bohemia, 734,498 tons; Moravia, 393,373 tons; Silesia, 17,632 tons. There are no data showing the production in Slovakia, statistics of the former Austro-Hungarian Sugar Commission being for the whole of Hungary, which included Slovakia.

The 1918–19 sugar production was 635,100 tons, representing the value of 2,385,000,000 Czechoslovakian crowns. Of this amount about 263,900 tons were exported.

The production of sugar for the whole of Czechoslovakia during the season of 1919–1920 was: Bohemia, 303,376 tons; Moravia, 146,975 tons; Silesia, 6,727 tons; Slovakia, 50,336 tons; total, 597,416 tons.

During the 1919–20 season Czechoslovakia exported a total of 340,516 metric tons of sugar, which went to following countries: France, 150,802 tons; Austria, 76,704 tons; Germany, 39,754 tons; Norway, 17,594 tons; Italy, 11,516 tons; Bulgaria, 10,156 tons; Yugoslavia, 10,080 tons; Poland, 8008 tons; Hungary, 6110 tons; United States, 3342 tons; England, 2210 tons; all others, 4236 tons.

The production of 1920–21 has been estimated to be about 715,725 tons.

The sugar industry of Czechoslovakia is essentially one of export. The Government has established a monopoly upon the sale of sugar within the country and the Czecho-Slovak Society for the Exportation of Sugar, which is under the Ministry of Finance, alone has the right to export sugar. At present the average cost of sugar beets is 300 crowns per metric ton; that for untaxed raw sugar, 4000 crowns per ton; and for taxed sugar, ready for consumption, 7000 crowns per ton.

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[1] *I.S.J.*, 1922, 231.

The Algebraical Theory of Imbibition: a Correction.

By an unfortunate slip in algebraical substitution, an error has occurred in the general formula for the Recovery in a system of Compound Imbibition, as given on page 235 of "Cane Sugar" (1921 edition). The reasoning is, however, correct, and the proper solution is as follows:—

The last line of the discussion of the case of two mills in series should read:

wherefore $e_1 = r\left(1 + \frac{r - r^2}{1 - r + r^2}\right) = \frac{r}{1 - r + r^2} = \frac{r\left\{(1 - r)^2 - r^2\right\}}{(1 - r)^3 - r^3}$

The discussion of the case for three mills in series should read:

In the first mill $r = \frac{e_1}{1 + e_2}$ or $e_1 = r\,(1 + e_2)$.

The second mill receives $1 + e_2 - r\,(1 + e_2) = (1 + e_2)\,(1 - r)$ to which is added e_3 from the third mill,

so that $r = \frac{e_2}{(1 + e_2)\,(1 - r) + e_3}$

whence $e_2 = r\,(1 + e_2)\,(1 - r) + r\,e_3$.

The third mill receives $e_3 + (1 + e_2)\,(1 - r) - \left\{r\,(1 + e_2)\,(1 - r) + r\,e_3\right\}$

$= (1 + e_2)\,(1 - r)^2 + e_3\,(1 - r)$

at the third mill $r = \frac{e_3}{(1 + e_2)\,(1 - r)^2 + e_3\,(1 - r)}$

whence $e_3 = r\,(1 + e_2)\,(1 - r)^2 + r\,e_3\,(1 - r)$

and $e_2 = r\,(1 + e_2)\,(1 - r) + r\,e_3$

wherefore $\frac{e_3}{e_2} = 1 - r$

substituting for e_3, $e_2 = \frac{r - r^2}{1 - 2\,r + 2\,r^2}$

and $e_1 = r\,(1 + e_2)$

whence $e = \frac{r - r^2 + r^3}{1 - 2\,r + 2\,r^2} = \frac{r\left\{(1 - r)^3 - r^3\right\}}{(1 - r)^4 - r^4}$

A comparison of this value for e_1, or the recovery, with that obtained for e_1, for two mills in series suggests that the general expression for e_1, for n mills is $\frac{r\left\{(1 - r)^n - r^n\right\}}{(1 - r)^{n+1} - r^{n+1}}$ and it can be shown that this expression is general.

By a coincidence the correct expression reduces to the form given in "Cane Sugar," p. 236, when and only when $n = 1$ and $n = 2$. For all other values of n the correct expression gives lower values, the differences being greater as r is smaller. Although the solution of the problem is incorrect, the same general deductions as developed on page 238 *et seq.* will follow from the correct formula, and the slope of the graphs in Figs. 144 and 146 remain substantially the same.

The above correction applies *mutatis mutandis* to the formula given on p. 254.

For the above correction I am indebted to Mr. P. H. Parr, who has given a discussion of this problem in a recent number of this journal.[1]

Noël Deerr.

The first issue of the *Journal of Scientific Instruments*, a monthly publication dealing with the principles, construction, and use of scientific instruments, has appeared for May, 1922. It is published by the Institute of Physics, London, with the co-operation of the National Physical Laboratory, and the subscription to it is 30s. per annum, post free.

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[1] *I.S.J.*, 1922, 95.

Correspondence.

THE FUTURE OF SUGAR IN BRITISH GUIANA.

To the Editor, "The International Sugar Journal."

Sir,—The attention of my Association has been drawn to an article appearing in the January issue of your Journal, entitled "The Future of Sugar in the West Indies," in which reference is made to two other articles published in previous issues of your Journal on "Labour in British Guiana" and "The British Guiana Sugar Industry," from the pen of Mr. F. I. Scard, F.I.C., the inference to be drawn from your article being that the preference now granted Empire sugars in the United Kingdom will not help to maintain and extend the sugar industry in British Guiana, and it should therefore be discontinued.

My Association is of opinion that Mr. Scard's articles are not as well informed as might have been hoped for, coming as they do from that source; and that the conclusions arrived at in your article are not correct, and are calculated to do this Colony a great deal of harm if left unchallenged. The statement that "there is no prospect of the inflation which has from time to time kept the British Guiana sugar industry going" is considered a wilful misrepresentation in support of a prejudiced argument. No one claiming any knowledge of the sugar industry in this Colony can plead ignorance that the short-sighted fiscal policy of the Home Government in permitting the entry into the United Kingdom of Continental bounty-fed sugars on level terms with Empire sugars was responsible for the very grave struggle for existence we have had for so many years, the effects of which we shall continue to feel for some years to come.

The Bounty System, designed by Germany, was aimed at the utter elimination of the cane sugar industry in the British West Indies, and although this fact was recognized, and also that it was succeeding in its object, nothing was done by Parliament to help us. The result of this unfair competition in this Colony necessitated the reduction of expenditure to a minimum in every direction in order to make ends meet. It was not possible to improve the factories, or to extend the cultivation, and in many instances fields already in cultivation were allowed to ratoon for too greatly extended periods. Perhaps the slight occasional improvement in the market for sugar during this period is considered as "inflation."

It is common knowledge that the effect of the Brussels Convention was to grant the industry a new lease of life, and that it was slowly recovering from the effects of the prolonged and ruinous competition it had had to face, when the Convention was abolished. (The good effects of the Brussels Convention cannot be described as "inflation" by any other than a person utterly indifferent to the claims of units of the Empire to a fair deal.) The United States also, by the heavy protection afforded to her possessions and protectorates with the object of building up a source of supply there for her own consumption, by this time had made it impossible for us to compete in her markets, but fortunately Canada rendered timely and invaluable assistance by granting a small preference, although she could not take our whole output; the outlook was gloomy when war broke out.

The period of inflation that did follow this was nowhere more regretted than in this Colony, as it was impossible to withhold a corresponding increase of wages, although it was realized it would be impossible to reduce these with the same rapidity when the deflation, which it was recognized would follow, took place. That there was foolish speculation no one will deny, but it is not correct to say that this resulted in the purchase of many estates in this Colony, for which extravagant sums were paid. The few estates that did change hands at exorbitant prices were for the most part small, and in most cases the failure of any of the new companies formed to purchase them will only result in an amalgamation with other neighbouring estates, not in a discontinuance of their cultivation, so that the prophecy that our total production will be reduced in a short space of time to not more than 50,000 tons is fortunately unlikely of fulfilment. The majority of estates proprietors devoted a very large proportion of the balance of profits that accrued, after paying excess profits duty, to the improvement of the factories and cultivation of their estates, and when the cost of supplies and wages becomes normal once more there will be no doubt as to their ability to stand up against a continuance of low prices, provided they are protected against unfair competition from the dumping of surplus sugars of Cuba and Germany. New milling plants with cane hoists have been erected and the boiling-houses have been balanced and modernized by the installation of new pans, triples, crystallizers, etc., on the majority of estates during the short period of prosperity.

The sudden slump of the market has occasioned a position that gives cause for grave anxiety, and as it again necessitates working on cropping lines to avoid disaster, the clock has perforce been set back. As Mr. SCARD, whose statements you have accepted unquestioned for the purposes of your article correctly points out, "the maintenance and development of the industry is a matter of primary importance to this Colony," but in ascribing the shortage in the labour supply and a deficiency in available land as the reasons why the crop is less now than it was 30 or 40 years ago, he is stating half truths. That there is a shortage of labour no one will deny, but it has been purposely limited in the last to the minimum necessary to enable the estates to carry on, that being all they could venture to do under the severe financial stress with which they were faced during the interval he quotes. He would not deny that until the stoppage of immigration from India no limit was placed on the numbers we were permitted to import, but that these were steadily decreased on account of the uncertainty that existed with regard to the future, and the constant risk of heavy loss which prevented the proprietors from gambling to any greater extent than they were already compelled to do. It speaks volumes for the nerve, enterprise, and also probably *sentiment* of those proprietors, that they kept up the brave fight for so many years, whereas they could have cut their connexion with the Colony without being unduly embarrassed by the immediate loss entailed of their capital investments in sugar estates, which have been a ceaseless cause for anxiety for so many years.

The policy forced on the proprietors of curtailing the Labour Supply has reacted, as when money was available to extend their cultivations the Labour was insufficient, and it is not now possible to draw on India. Mr. SCARD is quite wrong in saying that the "bulk of the Estates of the Colony have come to the end of their tether as regards new land." There is abundant new land available within the boundaries of most Estates in the Colony, but again the financial question has been the deciding factor, as money spent in taking in new land is not recoverable during the same year. There are also huge tracts of magnificent soil on the back boundaries of all the Estates in the Colony, but here again the cost of empoldering, etc., has been beyond the capacity of the Proprietors. There is some hope that the Government will undertake extensive Irrigation and Drainage schemes by a system of high level canals, the result of which will be to set free for cultivation these lands which are now swampy reservoirs for the existing totally inadequate irrigation schemes. There are also excellent lands available for many miles along the banks of the rivers, without taking into account the possibilities of land in the interior, which is at present inaccessible. That these lands are extraordinarily fertile no one can gainsay, when it is remembered that the fringe of coast land on which the present cultivation is carried on is identical with it, and that in many instances fields have been cultivated without rest for fifty years.

The evils in the system of cultivation to which Mr. SCARD draws attention, i.e., failure to rest the land, absence of green manuring and burning of trash, are recognised, but are the direct result of having to work on cropping lines for so many years. The flooding of fields has been increasingly and systematically practised on the majority of Estates in the Colony for several years past, with corresponding benefits, but a reduction of the area in cultivation as a result of flooding has not been entailed by the lack of available land to take the place of the fields so flooded as Mr. SCARD suggests, but to the expense of taking this in, and the difficulty of obtaining "tops" to plant up any extended area.

We are fully conscious that there is a great deal of leeway to be made up before our sugar industry is placed on a sound footing, but my Association holds strongly to the view that this will be done now that we are reasonably assured that our markets in the United Kingdom and Canada are secured by means of agreements guaranteeing a fixed preference for a term of years, which should prevent a repetition of the unfair competition of dumping with the sole object of driving the British sugar industry out of existence. The difficulties to be overcome in improving our Factories, and in providing mechanical means to supply the deficiency of our labour supply are being faced with more confidence, and you will doubtless be surprised to learn that extensive experiments have been carried out during the last few years in mechanical tillage on certain of the Estates, which have been entirely satisfactory, and that this method of cultivation has been permanently adopted for light soils, and it is hoped that a plough will shortly be designed to deal adequately with the heavier clay soils. Most of the difficulties that must exist in connexion with the use of ploughs hauled by tractors on fields surrounded by water, with innumerable drains, have already been overcome, and the others that remain are not sufficiently important to prevent the use of mechanism, and they will, it is felt, be overcome shortly. Investigations and experiments are also being carried on to obviate the use of manual labour now entailed in loading canes from the fields into the punts, and in various ways the evils of a shortage in the labour supply are resulting in benefit to the industry.

Your closing remarks disclose an utter forgetfulness of the lesson taught by the War as to the foolhardiness of dependence on foreign nations for the sugar supply of the British Empire, and the platitudinous advice you offer in your last paragraph discloses an unctuous indifference to anything but the belief apparently held by you in the fetish of Free Trade at all costs, even to the ruin of British Guiana and the British West Indies.

Yours faithfully,

H. FITZPATRICK,

British Guiana Sugar Planters Association. SECRETARY.

⁂ We have submitted a copy of the above letter to the writer of the article published in our January issue. He learns with satisfaction that the number of estates which were sold at inflated prices during the boom in sugar was less than he thought, and he has read with interest the account of the strenuous efforts being now made to improve matters as regards cultivation and manufacture. There are, however, several statements in the letter which he cannot accept as representing the facts of the case. It is stated that "there is abundant new land available within the boundaries of most of the estates" and that "there are also huge tracts of magnificent soil on the back boundaries of all the estates in the Colony." These may be true of some of the Berbice estates, but are not accurate as regards Demerara and Essequibo. The East Coast and West Coast Demerara estates already, with perhaps one or two exceptions, run up to the boundaries of the East Coast and Boerasirie water conservancies, while the East Bank estates are blocked by the Lamaha canal, the conservancy areas occupying the entire area behind them. In Essequibo the soil behind the estates is not fertile and the Capoey and Tapacooma lakes afford obstacles to extension. As to "the excellent lands available for many miles along the banks of the rivers," why, it may be asked, if that were the case did the Dutch settlers leave the rivers and go to the coast lands with their drainage difficulties? The old maps of the colony show that the banks of the Berbice and Demerara rivers were at one time lined to very considerable distances, especially in the case of the Berbice, with estates, and the old Dutch capital, Fort Nassau, was situated some sixty miles up the Berbice river. With regard to the "possibilities of the land in the interior" no less an authority than Sir JOHN HARRISON has designated them as being useless for agricultural purposes. The evils of the local system of cultivation are of very long standing, the system dating back to times immemorial, although they have admittedly been accentuated by the hard experiences of recent years. We extremely regret that the Planters Association should have thought fit in their opening paragraph to draw the inference from our article "that the preference now given to Empire sugar in the United Kingdom will not help to maintain and extend the sugar industry in British Guiana, and it should therefore be discontinued." The preference is given to British Colonial sugar generally and not merely to British Guiana sugar, and it is "up" to British Guiana to show what she can do with it. The letter of the Planters Association shows clearly that the sugar industry of that colony is very far from being in a satisfactory state, and affords justification for the gloomy views taken of it by writers in our pages. We certainly sympathize with the British Guiana Planters in the troubles which they have experienced, in common with other sugar growing colonies, as the result of economic causes; but the remedy lies largely in their own hands and if they are now being stimulated to modernize their industry especially along the lines of scientific agriculture, there is more hope for their ultimate success. But the crux of the matter is mainly one of cost of production rather than of price of sugar. The latter adjusts itself automatically, whereas the former depends upon local conditions and has always been relatively high in British Guiana. The Planters Association speaks of the dumping of surplus Cuban sugars in the U.K. market. On account of the large quantity produced, Cuban sugar receives no monetary advantage from its preferential treatment in the United States, and the price at which it is sold to the United Kingdom, as comparison with the f.o.b. sales to New York show, is a natural price; and if this is low from a British Guiana point of view, it is due to low cost of production, the result of a cheap cane and of efficient and concentrated manufacture. Similarly, just before the war, the 85 per cent. of the U.K. consumption which came in the form of beet from the Continent was mainly due not to bounties, for these had been abolished by the Brussels Convention, but to low cost of production. What is wanted in British Guiana is a cheaper cost of "cane required per ton of sugar." This end attained, the rest would follow.

As regards Mr. Kirkpatrick's argument generally on the Brussels Convention, it may be pointed out that this is mostly old history. He overlooks the fact that the Convention was abolished *after* and not before the war broke out; once the bounties ceased after 1902, they did not have occasion to appear again. The "gloomy outlook" at the outbreak of the war referred to by Mr. FITZPATRICK was not caused by any resuscitation of bounties such as his argument would suggest, but was due to other causes, one of which we have already indicated. In fact the position had arisen after 10 years of the Brussels Convention and when it was in full operation.

Finally, we must observe that the British Guiana Sugar Planters Association can hardly have been very regular readers of our pages during the last 20 years, or they would never accuse us, as they do in the concluding paragraph of the above letter, of possessing a belief in the fetish of free trade at all costs. Our bitterest enemies would never accuse us of that, for we have consistently opposed, in season and out, during the last 30 years or more, the doctrines of the Manchester school of economics, and our pages have at frequent intervals given space to attacks on this doctrine from the able pen of the late Mr. GEORGE MARTINEAU, C.B., all conceived with the object of combating the sugar bounty system in the interests of the British Colonial sugar industry. Far from being forgetful of the lessons of the war, we have been of recent years strong advocates of Imperial preference, especially for sugar, even though we may not have seen our way to back indiscriminately some of the claims put forward by colonial pleaders or to assume that all was well with the conduct of their sugar industry. The future of the British West Indies and British Guiana necessarily lies in their own hands, and if they cannot soon justify by results the granting to them of an Imperial preference, there is grave risk lest the day may come when in spite of all their friends can do they may be sacrificed once more on the altar of political opportunity. The Labour Party and the co-operative societies are at present blindly opposed to these preferences on sugar in the belief that these have to be paid by the consumer, and it will need very definite evidence of benefits to the sugar producing colonies and to our sugar consumption to convert them to acquiescence in the arrangement.—ED., *I.S.J.*

MILLING PLANT PERFORMANCE ESTIMATIONS.

TO THE EDITOR, "THE INTERNATIONAL SUGAR JOURNAL."

SIR,—I regret to notice that I have allowed a few errors to escape me in my article in your May and June issues, and while they are not of great importance, they may well be pointed out. On p. 254, Table III, the first two figures of the column RP should have been given as 0·35 and 0·68 instead of 0·34 and 0·67. On p. 300, second paragraph, 130 B.T.U. should read 1130 B.T.U., and on the bottom line, "not affected," should be "not appreciably affected." On p. 301 for "12 per cent. fibre, 7 rolls," it should be 6 rolls. On p. 304. the last sentence of the first paragraph, "The imbibition water . . . ." should be deleted.

With reference to the specification by "dilution," I might add that when it is required to determine the conditions of working of a given milling train, in order to give a mixed juice of a certain dilution from the normal juice, the procedure has to be indirect. If two different imbibitions are assumed, the extractions and the corresponding dilutions can be calculated, and then the final result found by interpolation. For instance, taking the 11-roll plant figured on p. 303, for 10 per cent. imbibition the extraction is 91·9, so that the extracted normal juice will be 80·9, and the mixed juice 84·5 per cent. of the cane, giving a dilution for the mixed juice of (84·5 — 80·9)/180·9 = 4·5 per cent. Similarly, for 20 per cent. imbibition, the dilution will be found to be 13·6 per cent.; then a simple interpolation shows that, for, say, 10 per cent. dilution of the mixed juice, the imbibition must be just over 16 per cent. on the cane, which agrees with Table VI, for which the 16 per cent. imbibition shows 9·7 per cent. dilution.

P. H. PARR.

Publications Received.

Manuel de Sucrerie: Technologie Sucrière: Betterave, Sucre à Canne. By J. Rouberty. (J.-B. Baillière et Fils, Paris.) 1922. Price: 10 francs.

One would expect much of a work in the preface to which it is explained that for the use of the young man unable to undergo a course of professional instruction what is required is a book that forsees all difficulties, knows how to resolve them clearly, is abundantly illustrated, also a book which unites sound learning with the practical skill that is equally indispensable. After the perusal of these words, one turns rather eagerly to the text, but unfortunately with disappointment. In fact, this is a book which we are decidedly unable to recommend for the use of any young chemist or engineer. It teems with erroneous statements, the following being among a large number noted while turning over its pages:—

> Sugar cane belongs to the species *Saccharum officinalis*; the beet contains 8 to 12 per cent. of sucrose, which quantity under exceptional circumstances may reach 13 and even 15 per cent.; the only varieties actually used in the industry are the white Silesian with pink or green collar; for washing the roots entering the factory, an open-work iron or wooden cylinder 3 to 6 m. long is used; after liming and carbonating the raw beet juice, and allowing the liquid to subside, it is decanted off, and run to the animal charcoal filters; the Steffen method of extracting sugar from beet molasses does not give the results expected; the diffusion process of extracting juice from the cane is at present in use in Cuba and Australia; cane juice on leaving the mills is filtered through presses; in refining, 1-2 per cent. of blood is added in the blow-up; and all the raw sugar is melted as received in the refinery without previous washing in the centrifugals.

Then, in the section on chemical control in the beet and cane factory, several errors are introduced. In addition to the inaccuracies which abound in this book, there are numerous serious omissions; and to mention only one, an account of cane milling as now carried out is lacking, while the illustrations leave much to be desired, in respect both of the subjects selected and the clearness of the photographs or drawings represented. We are sorry to criticise the book in this manner; but are compelled to say it could hardly have been written by one engaged in the practice of sugar manufacture. Obviously it has been compiled from sources long out-of-date, and by a writer having very little real acquaintance with the subject he professes to teach.

The Beet Sugar Industry in the United States in 1920. By C. O. Townsend. Bulletin No. 995. (U.S. Department of Agriculture, Washington, D.C., U.S.A.) 1922. Price: 20 cents.

Contents: Beet sugar mills in the U.S.; soil; topography; climate; beet stand; water; drainage; seepage; soil fertility; crop rotation; competing crops; farm equipment; by-products and live stock; labour problems; diseases; roads; contracts; beet seed; and bibliography.

The Sugar Beet Nematode in the Western States. By Gerald Thorne and L. A. Giddings. Farmers' Bulletin 1248. (U.S. Department of Agriculture, Washington, D.C., U.S.A.) 1922. Price: 5 cents.

Contents: Nature and distribution of the pest; the most probable means of its spreading; and the preventative measures and practical means of control.

Review of Current Technical Literature.[1]

Distribution of Cane on the Carrier in Milling. *E. W. Kopke.* *Sugar News, 1922, 3, No. 4, 155.*

There is still room for much improvement in connexion with certain phases of milling (remarks the writer); and one such point that has surely suffered in most instances through insufficient attention is the distribution of the cane on the carrier. A considerable number of tests have been made on different mills to determine the influence of such irregularities on the results. In many cases there was as much as 2 per cent. difference in the extraction between those places where the feed was heaviest and lightest. Undoubtedly one reason why this point has not been given better attention is that appearances are most misleading. Very great irregularities on the carrier practically disappear, and the blanket looks just about as uniform as could be wished for after having passed the crusher or first mill. Levelling knives lengthen out irregularities of cane distribution on the carrier, but the variations in weight or mass of fibre *across the width of the carrier* are not properly corrected by any device now in common use. From the data that the writer has collected in this connexion, it would appear to be very beneficial towards greater uniformity of milling, better extraction, etc , to even up the cane on the carrier before it reaches the first knives. It may appear simple to do this after the cane has passed the levelling knives, but there are certain complications at this stage that would give trouble. Milling results start with the distribution of the cane on the carrier. Irregularities at this stage are only partially corrected afterwards, and these irregularities have an important bearing on the extraction. This condition is one primary reason why many factories are not getting better milling results.

Payment of the Planter for his Cane in Porto Rico. *M. Donchi.* *La. Planter, 1922, 68, No. 15, 243.*

Formerly the *colonos* supplying cane to the Central Aguirre, Porto Rico, were paid a flat rate for the cane they brought to the mill, viz., 5 or 5½ per cent. of the 96° sugar on the weight of the cane.[2] This was paid indiscriminately for all canes whether of superior or inferior quality. Accordingly at the suggestion of Dr. Donchi a system of payment based on the quality of the cane was adopted, and it was decided to pay the *colonos* $\frac{9}{16}$th of the 96° sugar (or its equivalent in money) manufactured in the mill from their respective canes, this settlement being adopted as just by both parties concerned. Calling the quantity of sucrose recovered from the cane of each *colono* K, this value was calculated according to the following formula:

$$\text{K} = \frac{\text{Total sucrose recovered} \times \text{average per cent. sucrose content of the } \textit{colono's} \text{ juice} \times \text{weight of his cane.}}{\text{General average per cent. sucrose content in juice of all cane} \times \text{total weight of all the cane.}}$$

and of this amount of sucrose $\frac{9}{16}$th calculated to its equivalent of 96° sugar was given to the *colono*. This cane settlement was made every month, and the system was found to work very satisfactorily.

Remarks on the Chemical Control Results of the Philippine Centrals. *B. Serrano.* *Sugar News, 1922, 3, No. 4, 156-159.*

Referring to the figures for 10 Philippine centrals (1920-1921 crop), recently published,[3] it is remarked that in regard to the results for No. 1 in the list, there is a noticeable error at first sight, namely 10·38 for the sucrose in the cane, which figure actually indicates the sucrose recovered ; while the 9·55 per cent. of fibre in the cane is inadmissible, as it supposes rather considerable undetermined losses. However, considering only the analysis of the crusher juice, and the recovery by means of the author's formula,[4] the work in this central was what could be expected, and is in proportion to the purity of the molasses, viz., 30·40 (apparent). Central No. 3 publishes figures which do not call for comment; and in the case of No. 4 the fibre in the cane, 13·90 per cent., seems rather excessive as an average. As to Central No. 5, the gravity purity of the molasses, 41·02, decreased the recovery 1·5 per cent., but this was compensated by the 10·03 per cent. of fibre in the cane, which gives the theoretical recovery of the formula. In Central No. 6 the gravity purity of the molasses was 39·26, which means a loss of about 1 per cent. in the recovery, though this is compensated by the difference in the fibre, viz., 11·20, and by the polarization of the sugar, which was 96·06. From the purity of the crusher juice of Central No. 7, it will be concluded that this mill has been grinding very poor cane, and in such cases deceptive results are obtained when the ordinary methods of juice analysis are applied, but if the purity of the syrup instead of that of the crusher juice be taken, the results given by the author's formula and the yield actually obtained coincides exactly. Central No. 8 has obtained 0·06 picul less than that indicated by the author's formula, but this difference is fully explained, first by the gravity purity of the molasses being 39·99, and secondly by the high amount of sucrose in the press-cake. On the whole in the case of this factory the figures reported agree well with the actual work of the factory.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*

[2] For a discussion on this subject by chemists in the Philippines, see *I.S.J.*, 1921, 621–623 ; 1922, 46, 226.

[3] *I.S.J.*, 1921, 688.

[4] *I.S.J.*, 1922, 46.

This cannot be said of the results for Central No. 9, in which the recovery was 1·98 piculs per ton, while the author's formula indicates 1·94, an excess of 0·04 picul, which is nearly 2 per cent. of sugar. Then the gravity purity of the molasses, 43·02, implies a loss of another 2 per cent. over that which would result had it been 36·50, so that, according to this figure, the recovery should have been 0·04 picul per ton less than that of the formula, that is, 1·90. Even supposing the undetermined loss to have been nil, and that in the press-cake to have been an average one, it appears that the loss should have greatly exceeded 0·08 picul, or nearly 4 per cent. more than it should have been. Coming now to the last column, it is noticed that in the case of Central No. 10 there was disparity between the actual recovery and the yield according to the author's formula, that is 1·84 actually obtained, as compared with 1·72 calculated. Probably in these figures the greatest error is in the analysis of the crusher juice, and confirmation of this lies in the fact that the ratio between the sucrose in the cane and the crusher juice is 86·4, which is higher than it usually is found to be. Calculating back with Serrano's formula one finds the more reasonable figure of approximately 16·1 per cent. sucrose in the crusher juice, which is 0·42 more than that shown in the report.

DEFINITION OF THE "NETT WEIGHT OF CANE GROUND." *F. R. Böhtlingk. Archief, 1921, 29, No. 42, 1359.*

Mutual chemical control returns received at the Java Experiment Station show that the expression "nett weight of cane ground" does not seem to be quite clearly understood. Thus it is noticed that in some factories the weight of a lorry of cane is ascertained as it stands, then the percentage of trash and soil is estimated (sometimes the roots even being removed), the weight of the cane in the lorry on the weigh-bridge being diminished by the amount of trash and soil found. In other factories it actually appears that cuttings for plantings are taken from the weighed cane ready for milling without any deduction being made; and it is obvious that such methods lead to inaccurate results in chemical control. By the term "nett weight on cane ground" is understood that amount passing into the crusher (or the first mill), i.e., including such trash and dirt that may accompany it. Most of this extraneous matter finds its way into the bagasse and the remainder into the raw juice. That part passing into bagasse of course increases the dry substance, and causes the loss of polarization to be higher. That going into the juice is mostly retained in the sand catchers (if installed) and is weighed, and the amount deducted from the weight of cane; while that which is not separated in this way is accounted for by the scum correction. Properly also all the dirt falling from the cane between weighing bridge and carrier should be collected and weighed periodically, and the amount added to the weight of dirt found in the sand catchers.

Review of Current Technical Literature.

IMPROVED METHOD FOR THE PREPARATION OF RAFFINOSE FROM COTTON SEED MEAL. *E. P. Clark. Journal of the American Chemical Society, 1922, 44, 210-213.*

Cotton seed meal is extracted by percolation (and it must be done quickly); the extract purified by basic lead acetate, and the excess of lead removed by the addition of oxalic acid, the sugar being then thrown out of solution as the insoluble calcium raffinosate, which compound is later separated by filtration, and decomposed with carbon dioxide. The resulting solution is evaporated under diminished pressure until it reaches 70-75° Brix, at which point the raffinose is caused to crystallize out by the addition of alcohol. A simple device for the carbonatation of the raffinosate is described.

RECOVERY OF THE AMMONIA EVOLVED DURING THE MANUFACTURE OF BEET SUGAR. *K. Andrlik and Vl. Skola. Listy cukrovarnické, 1921-22, No. 18, 157; No. 19, 169; Zeitsch. Zuckerind. cechoslov. Republik, 1922, 45 (iii), No. 25, 275-285; No. 26, 287-292.*

Experiments are described demonstrating that in the case of the condensed water of the evaporators only 88·7 per cent. of the nitrogen is present as ammonia, the rest being there as amides and other such compounds. On distilling this condensed water, it was found that more than one-third had to pass over before 90 per cent. of the ammonia could be evolved, so that it was present in the distillate in a very dilute form. Aspirating air through the heated evaporator condensed water gave no better results. Probably the best method of separating the ammonia from evaporator condensates is distillation with the use of a suitable dephlegmator, when in order to realize a yield of 85-90 per cent., it is necessary to distil over only about 7 per cent. of the liquid, though in this case also the ammonia is highly diluted in the distillate. It is concluded that technically such a method of recovery is uneconomical on account of the cost of the fuel required for the distillation, even if only 5 per cent. of the original volume of the liquid were evaporated, the yield of the ammonia capable of being thus recovered being comparatively small.

SEPARATION PREVIOUS TO CARBONATATION OF THE PRECIPITATE PRODUCED BY THE LIMING OF BEET JUICE. *Vl. Stanek and Jiri Vondrak. Zeitsch. Zuckerind. cechoslov. Republik, 1922, 45 (iii), No. 27, 299-306.*

A review of the literature of the clarification of beet juices shows that many chemists have investigated the possible advantages of previously removing the precipitate formed on the addition of lime previous to proceeding to the carbonatation operation. BLOCK, for example, has advocated this procedure quite recently[1], stating that the precipitate resulting on the addition of a small amount of lime to the heated juice can be easily removed by centrifuging and later passing through the Plauson ultrafilter, while the amount of lime subsequently required for effecting carbonatation is then less than ordinarily, the slimy constituents or colloidal impurities having already been removed. On the other hand, CLAASSEN has controverted this idea,[2] pointing out that such a procedure leads to typically insufficently clarified juices, holding much lime in solution. In order to decide the question, experiments have been carried out by the authors, in certain of which the Sacek centrifugal,[3] was used for the separation of the precipitate resulting on liming. In the other experiments, the operations were carried out on a laboratory scale only, separation of the precipitate being effected by means of a Buchner funnel, the procedure being to lime the juice at 80°C. with either 0·22 or 0·40 per cent. of CaO, filter off the subsided precipitate, re-heat to 85°C., add either 0·5 or 2·0 per cent. of lime, carbonate to 0·10 per cent. alkalinity, filter, re-carbonate to neutrality, boil, and finally again filter. Analytical results were obtained showing clearly that when only 0·5 per cent. of lime had been added after the preliminary separation of the precipitate, the clarification was incomplete. A much larger addition is altogether necessary; and the net conclusion is that it is not possible to economize in lime by the preliminary removal of the precipitate produced on defecation in the manner indicated.

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[1] *Deut. Zuckerind.*, 1918, 383; 1919, 321.

[2] *Ibid.*, 1918, 191; 1919, 57, 359.

[3] *Zeitsch. Zuckerind. cechoslov. Republik*, 1919-20, 44, 51.

Some Particulars Regarding the Production of Alcohol-Ether Motor Fuel.

J. P. Foster. Sugar News, 1922, 3, No. 2, 73-76.

It seems to be thought that the manufacture of motor alcohol containing ether is a very complicated process. Yet this is not so, the entire procedure consisting of: weighing the molasses; diluting it with water; adding yeast and fermenting; distilling the alcohol; production of the ether; denaturing and mixing; none of which operations entails any difficulty. Certain precautions are naturally necessary, and that which is above all is cleanliness throughout. Fermenting tanks should be so located that they are flooded with light and air, inside and outside, and they should be made of material which can be readily scrubbed. As acetic fermentation usually starts simultaneously with alcoholic fermentation, or only soon after, the fermented wash should be distilled before the "dry" stage is reached, the loss of alcohol by conversion to acetic acid being greater than is usually incurred by incomplete fermentation. It is wise to install a still which is 50 per cent. too large rather than one which is "large enough," for if the still has no over-load capacity, the quality of the output will suffer, spirit of lower proof will be run, and the quality of the ether and finally the uniformity of the motor spirit will suffer. In regard to the ether still, it must be built of the best grade of lead; its shell must be constructed so that entrance to it may be easily effected for repair; the heating system must also be built of the best grade of lead, and must be so designed that it may be easily removed; a safety blow-off device and automatic vacuum-breaker must be provided; and (since a sight-glass is worthless) a suitable means of determining the level of the boiling liquid must be installed. Perhaps the scrubber is one of the most important apparatus in the distillery, and in selecting it, means must be provided for efficiently neutralizing the ether *completely*, thus ridding it entirely from entrained sulphuric acid from the still. It is claimed by the author that the Foster process of making alcohol-ether fuel[1] is the only successful one used in America. When it was first installed in Hawaii (where there are now three distilleries), the Revenue regulations made it necessary that the alcohol should be made in bonded premises, and after denaturing removed to another building for the production of ether. However, the Secretary of the Treasury has now approved Decision 3098, by which permission is given for the withdrawal of alcohol during the process of its manufacture for conversion to compounds unsuitable for use as an intoxicating beverage, *e.g.*, ether, and that this conversion may be carried out in the building or room in which the main alcohol plant is situated.

Production of a Fodder from the Non-Sugars of Raw Beet Juice.

Zdenek Vytopil. Zeitsch. Zuckerind. cechoslov. Republik, 1922, 45 (iii), No. 21, 236-237.

During the purification of beet juice by the addition of lime, non-sugars are precipitated, and pass into the scums, which find use only for manuring purposes. Yet the food value of these substances is not inconsiderable. **Claassen** has taken out a patent[2] for their recovery from raw beet juice by the addition at a temperature of 85°C. of only so much milk-of-lime as to cause their precipitation, that is, about 0·26 per cent., filtration through presses following. Since, however, the precipitate thus obtained is soft and slimy, and filtration is difficult,[3] the author has modified it by the addition of finely chopped straw, obtaining in this way a juice which passes quickly through cotton cloth. After drying the precipitate thus obtained, it was found to have the following composition:—Water, 10·6; ash, 26·0; fibre, 13·3; albumenoids (N × 6·25), 7·5; fat, 0·7; sugar, 12·0: nitrogen-free substance soluble in water, 29·9 per cent. However, from 100 parts of the diffusion juice, only 1·5 parts of this precipitate containing 90 per cent. of dry substance were obtained.

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[1] *I.S.J.*, 1922, 159, 219.

[2] German Patent, 307, 575 of 1915.

[3] Prof. **Herzfeld** examined this process at the Institut für Zuckerindustrie, and criticized it on another ground, namely, the very high ash of the product obtained. See *Deut. Zuckerind.*, 1920, 45, 243.

Review of Current Technical Literature.

STRUCTURAL STEEL WORK OF PHILIPPINE CENTRALS. *S. Garmezy. Sugar News, 1922, 3, No. 4, 145-150.*

All the modern centrals erected in the P. I. have steel-framed buildings covered with galvanized-iron roofing and siding. This is believed to be the cheapest and best form of construction for the heavy loads that have to be sustained. Lumber is not used, because of its poor lasting qualities and because the loads are too heavy for economical designs of lumber and reinforced concrete construction. The floors are generally constructed of reinforced concrete so that cleanliness can be maintained. On account of atmospheric conditions, the steel and galvanized-iron should be well cared for. The steel should be painted every three or four years, and no dirt should be allowed to gather around the metal at the floor levels. In selecting galvanized-iron roofing and siding, a grade with 2½ ounces of spelter per sq. ft. should be specified. In old buildings in the Philippines where galvanized-iron roofing has been in place for from 40 to 50 years, and is still in good condition, it is found that the spelter runs from 3 to 4 ounces per sq. ft. Much of this material now used in the archipelago presents only 1¼ ounces of spelter per sq. ft., and if this grade be used corrosion soon takes place, the buildings become unsightly, and within a few years heavy replacement charges are necessary.

DETERMINATION OF THE BRIX DEGREE OF RAW CANE JUICES AFTER TREATMENT WITH KIESELGUHR. *W. D. Helderman. Archief, 1921, 29, No. 48, 1708-1713.*

Difficulty is often experienced in obtaining a satisfactory reading with the Brix spindle in the case of raw cane juices which refuse readily to subside and de-aerate owing to the presence of colloids. In the Chemical Department of the Java Experiment Station, about 750 c.c. of the troublesome raw juice were mixed with 15 grms. of kieselguhr in a litre flask fitted to a reflux condenser; the liquid heated to boiling point as quickly as possible; cooled to room temperature; the condenser rinsed through with the juice in case any drops of condensed vapour remained adhering there; and the whole passed through large folded filter-paper, being finally brixed. Preliminary experiments showed practically no difference at all to exist between the Brix of juice allowed to subside during one hour, and that of juice treated in the manner just described, one experiment giving 19·60° and 19·58° for the two determinations respectively. These figures (and a number of others which were obtained) appear to indicate that the elimination of the colloidal matter by means of the kieselguhr treatment makes very little difference in the Brix determination. However, a large number of other trials showed that the results are not so satisfactory if one subsequently desires to determine the purity of the juice, since during the kieselguhr treatment more or less inversion of sucrose occurs; while, on the other hand, with both acid and neutralized juices, it was observed further that the purity increased now and again considerably. As the conclusion to be drawn from these experiments, it is stated that this method of treatment with kieselguhr can be applied only to the determination of the Brix degree, being untrustworthy when one desires also to ascertain the sucrose content and the purity of the sample.

REMOVAL OF OIL AND INCRUSTATION FROM THE EXTERIOR OF EVAPORATOR TUBES. *P. Vrins. Archief, 1922, 30, No. 15, 245-247.*

It would appear that in many factories during the over-hauling of the plant insufficient attention is given to the removal of the layer of lubricating oil that accumulates on the outside of the tubes in the calandria of the first effect of the evaporator, it being well known that such a layer greatly diminishes the coefficient of transmission of heat.[1] Generally, in order to free the exterior of these tubes from oil, grease, and the incrustation which is caused by oxidation, they are taken out and separately cleaned; but this is an operation that requires some care, and often the result is that a good number of renewals are necessary. It would of course be better to be in possession of some way of cleaning the tubes *in situ*.

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[1] *I.S.J.*, 1920, 170.

A method that may be applied is almost to fill the steam chamber with water; afterwards add some benzine; and then allow the water slowly to flow out, the layer of benzine thus coming into contact with the oily layer on the surface of the tubes so as to dissolve it. If the solution of the oil is not complete with the first attempt, the operation is repeated, which is generally effective. However, the use of benzine in this manner, owing to its inflammability, is attended with some danger, and preference should be given to the following procedure, which further removes (it is said) incrustation caused by oxidation. Immediately after finishing grinding while there is yet steam in the house, the chamber is boiled out with a 1 per cent. solution of caustic soda, then washed with water, and filled with paraffin oil, which after a time is finally run away, and kept for use on another occasion or else sold for illuminating oil. In following this second and preferable method of cleaning the outside of evaporator tubes, first the steam inlet valve of the first effect is closed; and second the condensed water pipe leading to the steam trap or pump is disconnected and fitted with a T-piece, one arm of which is made to point up and the other down. To the former is fixed a steam cock, and connexion made with a source of supply of steam; while to the latter is also fixed a small cock and then a run-off tube. In order to introduce the caustic soda solution, the ammonia or incondensible gas valve is used; and the boiling is effected by blowing in steam through the upper arm of the T, this being continued for some time. Then the soda solution is run away through the lower arm of the T; the chamber cleaned out with water; and lastly, filled in the same way with the paraffin oil, which is allowed to stand in contact with the tubes for a sufficient time for the solution of all oil and grease before finally being discharged.

Determination of Reducing Sugars by Titrating a Solution of the Cuprous Oxide with Standard Alkali.

A. Hanak. *Zeitschrift fur Untersuchung der Nahrungs und Genussmittel, 1921, 42, Nos. 9-10, 248-250.*

It is remarked in the introduction to this note that though in the determination of reducing sugars, instead of weighing the cuprous oxide obtained, numerous methods have been devised for its volumetric determination, yet these are usually either complicated or costly, or may be both; and that a simple and inexpensive procedure is greatly desired. This want is now supplied by the author's method of titrating heavy metals with standard alkali,[1] using the two indicators methyl orange and phenolphthalein in suitable combination, the procedure being as follows: After boiling together the sugar and Fehling's solution the precipitate of cuprous hydroxide resulting is separated in a suitable manner, washed, and treated with sufficient *aqua regia* for its solution, the operation being hastened by heating for a few seconds on the water-bath. This solution of copper is introduced through a filter into a titration flask and diluted to 250 or 300 c.c. with distilled water (free of carbon dioxide). After cooling to laboratory temperature, the solution is neutralized by the addition of a strong solution of alkali, using methyl orange at this stage for the indicator, the addition being continued drop by drop until a distinct pink colour appears, after which point the saturation is completed by running in N/2 alkali till the pink passes into yellow and finally to yellowish-green, the indication that neutrality to methyl orange has been reached. Recognition of this point is the most difficult and important part of the method, and when it is effected it means that the acid is neutralized and that the pink thus produced together with the blue of the copper solution blends to form the yellowish-green tinge. Now the titration proper of the copper commences. Phenolphthalein is added and the standard alkali is run in until the colour changes to red, after which the titration is continued hot, until the red is permanent after three minutes' boiling. Then 1 c.c. of the N/2 alkali = 0·0159 grm. of Cu. This method is stated to give entirely exact results, provided the usual sources of error in the volumetric method (such as inexact titre of the alkali, inaccurate calibration of the burette, and non-observance of the temperature of standardization, etc.) are avoided.

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[1] *Chemiker Zeitung*, 1919, 43, 69.

Review of Current Technical Literature.

SUGAR BEET GROWING IN HOLLAND AND BELGIUM. *R. G. Ridling. Journal of the Ministry of Agriculture, 1922, 29, No. 1, 65–71.*

The writer (of the School of Agriculture, Cambridge) has spent several weeks in the Low Countries making a close study of the methods adopted there in beet cultivation, and here deals with some of the points that may be of service to British growers. His remarks are made under the headings of: rainfall; place in rotation; tillage; manuring; seeds and sowing; inter-tillage; harvesting; topping; and the use of tops. *Inter alia,* it is said that beets follow normally after a straw crop. For long there has been dissatisfaction among farmers with the root crop on account of the high cost of production and the relatively low return. Whether beet will assist the farmer in this matter is still a subject for experiment, but it can conceivably take the place of part of the roots now grown with some financial benefit. The cleaning of the land is as easy under a crop of beet as under swedes or mangolds, and is of just as much importance, so that its introduction would cause no disturbance of present practice. In regard to mechanical harvesting, this is employed in Holland and Belgium only where the beets are grown on a large scale, though various machines have been devised which top and lift expeditiously and efficiently. One of these drawn by 3 horses topped and lifted 2½ acres in a day of 8 hours.

DEFECTS OF THE COEFFICIENT OF PURITY AS A CRITERION IN CHEMICAL CONTROL. *C. W. Schonebaum. Chemisch Weekblad, 1922, 19, No. 1, 2–3.*

In discussing the value of the coefficient of purity as a criterion in the chemical control of manufacture or refining, it is mentioned in the first place that when comparing the purity of two products (juice before and after clarification for example) the possible error in its determination is not inconsiderable by any means, especially when operating on dilute liquids. Thus in the case of a raw juice having dry substance and sucrose contents of 13·0 and 11·8 per cent. respectively the purity would be 90·8°; but if in both determinations the error was 0·1 per cent., making the values 13·1 and 11·7 per cent., then the purity would become 89·3°, that is a difference of 1·5.° Then the value of the purity figure may be regarded from another point of view, it being assumed that during working 10 per cent. of the sucrose is decomposed into organic non-sugars. If in the example already used, the amount of dry substance remains the same, namely 13·0 per cent., the purity falls to 81·7°. Assume on the other hand that the sucrose is transformed into volatile substances, so that the dry substance diminishes. Then dry substance is 13·0 — 1·18 = 11·82 and the sucrose content 11·8 — 1·18 = 10·62, making the purity fall to 89·8°. It is therefore seen that between the first purity value cited above, namely 90·8°, and the last obtained, there is a difference of 1·5° when 10 per cent. decomposition had occurred, and one of 1° when an error of only 0·1 per cent. in both the dry substance and the sucrose determinations had occurred. Figures could also be produced showing that even with a moderate amount of sucrose decomposition a purity value higher than originally might quite well be obtained when some of the non-sugars produced are volatilized. It follows therefore that if an indication of the value of a process of clarification is to be deduced from the purity values, then these should be the average of a good number of determinations.

DETERMINATION OF HYDROSULPHITES IN THE PRESENCE OF SULPHITES AND BISULPHITES. *D. de Bacho. Giorn. Chim. Ind. Appl., 1921, 3, 501–502; J. Soc. Chem. Ind., 1922, 41, 250A.*

Details of a method are given in which the hydrosulphite is treated with an excess of formaldehyde previous to titration with N/10 iodine, a solution thus being formed which is highly resistant to oxidation by atmospheric oxygen, the influence of sulphite, bisulphite and metabisulphite being eliminated.

A CYTOLOGICAL EXAMINATION OF SOME VARIETIES AND BASTARD VARIETIES OF THE GENUS *SACCHARUM*. *G. Bremer. Archief, 1922, 30, 1-111, 229–238.*

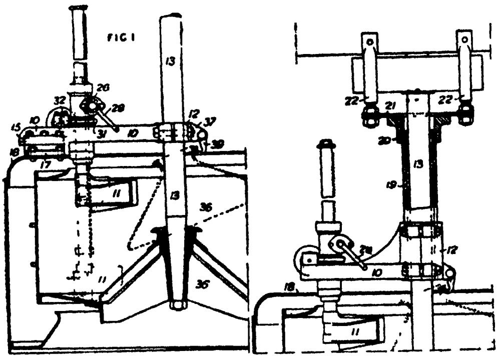
J. P. O.

Review of Recent Patents.[1]

UNITED KINGDOM.

PLOUGH DEVICE FOR THE DISCHARGE OF CENTRIFUGAL MACHINES. *Andrew R. Robertson and Alex. F. Dunsmore,* of 98, Dundas Street, S., Glasgow, Scotland. *178,380.* August 25th, 1921.

According to this invention, the plough (which with its operating and allied gear is of substantially known form) is supported on a member which is operatively connected to the machine spindle on the one hand in suchwise that while it does not rotate therewith it is constrained to follow it in its oscillatory movements, and on the other hand it is flexibly anchored to a fixed part in suchwise that while it may follow the oscillatory motions of the spindle it is constrained against rotation therewith. In carrying out the invention according to an illustrative example, the member carrying the plough and its mechanism is in the form of an arm radially disposed over the basket, and having at its inner end a bush engaging the spindle, and, at its outer end, universally pivoted to the stationary monitor casing, for example, pivoted on a block sliding in radial guides on the monitor casing. According to another illustrative example the radial arm having a bush engaging the spindle is connected by a sleeve loosely embracing the spindle to a plate flexible enough to give the desired flexible anchorage, which plate is in turn rigidly supported from a stationary overhead part of the machine. Illustrations of these two examples are given in Fig. 1, a part sectional elevation of the first example; and in Fig. 3, which is a part sectional elevation of the second example.



Referring now to Fig. 1, the radial arm *10* supporting the plough *11* has at its inner end a bearing *12* on the machine spindle *13* and at its outer end it slides between guides *15* on a block pivoted on a stud in a plate *17* bolted to the casing *18*. The plough is raised or lowered by means of a handle *28* which rotates a pinion *26* engaging the rack *29*. A ratchet retains the rack in any position to which it is moved. The sleeve *25* is rotatably mounted in a boss on the arm *10* and carries a worm-wheel *31* engaged by a worm *32* operated by a hand-wheel for moving the plough to and from the wall of the basket. Lugs *37* on the bearing *12* carry the pivot for the hook *39* which holds the valve *36*. In the modification shown in Fig. 3, the bearing *12* at the end of the arm *10* surrounds the sleeve *19* which loosely encircles the spindle *13*; the sleeve is secured by a flanged piece *20* to a flexible plate *21* supported by four hangers *22*.

PRODUCTION OF DECOLORIZING CARBON. *China Sugar Refining Co., Ltd.; George M. Shaw;* and *Hector M. McTavish,* of Hong-Kong. *124,638.* May 31st, 1918.

Notice is given in the *Illustrated Official Journal (Patents)* for May 24th, 1922, of the British Patent Office that the patentees mentioned above have applied for this patent[2] to be endorsed "Licenses of Right."

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[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C 2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2fr. 00 each).

[2] For abstract see *I.S.J.*, 1919, 310.

PURIFICATION OF JUICE USING A SOLUBLE ALGINATE. *Soc. Ricard, Allenet & Cie.*, of Deux-Sèvres, France. *177,761 : addition to 173,735.* November 22nd, 1921; convention date, March 26th, 1921.

The process for clarifying saccharine juices by precipitating an insoluble alginate described in the parent specification[1] is applied to liquids of different classes. As examples are described the treatment of tannin extract, barium formate being used as the precipitant; of fermented beetroot juice with an alginate and sulphuric acid; and of the waste water from starch factories with an alginate and lime.

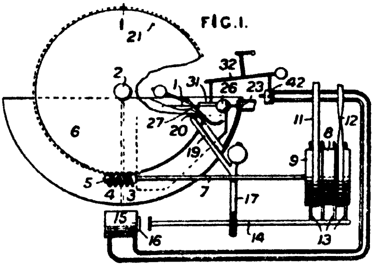
DOUBLE CRUSHER FOR CANE MILLS.[2] *L. W. Goold* (*Fulton Iron Works Co*, of St. Louis, Missouri, U.S.A.). *175,903.* March 4th, 1921.

ACTIVATED (OR DECOLORIZING) CARBON. *British Thomson-Houston Co., Ltd.* (*General Electric Co.*, of New York, U.S.A.). *176,476.* December 20th, 1920.

Carbonaceous materials are distilled for about eight hours in refractory retorts at about 700–1000°C., and steam or other oxidizing gas is admitted after at least two hours. The product may be used for the following purposes, namely: the clarification of liquids and purification of water; the administration of anæsthetics; as an absorbent for use in gas masks; as a catalyst; the production of high vacua and removal of the last traces of gas from incandescent lamps, etc.; the removal of arsine from hydrogen, and hydrocarbon vapours from air and natural and artificial gases; the recovery of solvents, for example the absorption of petrol from an admixture with air, obtained by distilling off excess solvent from rubber solution; the removal of petrol from natural gas.

VACUUM LEAF FILTER. *Wilhelm Mauss*, of Johannesburg, Union of South Africa. *177,067.* April 4th, 1921.

The present invention has reference to vacuum leaf filters of the kind in which the leaves are periodically withdrawn from the tank for cleansing and then returned; and especially has it reference to such filters in which the leaves are mounted on a rocking shaft which oscillates to transfer the leaves from the filtrant tank to a "stripping tank," in which the cake is removed, after which the leaves are returned to the said filtrant tank. The invention consists in a filter having a cycle of movement of the leaves which includes a period of immersion in the filtrant tank without movement, during which the cake is formed; then movement without substantial interruption, away from the filtrant tank, and back thereto, during which the leaves are cleaned. Referring to the drawing, it is seen that an oscillating shaft *2* carries the leaves *1* over from a filtering-tank *3* to a tank *4*, which receives the cakes stripped from them. The liquid is supplied to the tank *3* through a butterfly valve *23* controlled by a float *26* in the tank. When, on account of the decreased permeability of the leaves, the liquid level in the tank *3* rises, a float *31* turns a counter-weighted lever *32* and actuates a valve *42* controlling the supply of a motive fluid to a motor *15*, which operates reversing belt-gearing *8* . . . *13*, driving the worm-gearing *5*, *6*. The leaves are thus lifted over into the tank *4*, the motion continuing until a pin *21* on the wheel *6* contacts with a counterweighted lever *19*, the arm *17* of which engages the rod *14* and moves the belts so that the motion of the shafts *2*, *7* is reversed. A pin *20* on the wheel *6* brings the lever *19* and the rod *14* into the neutral position to stop the motion when the leaves return to the filter tank. The valve *23*, while the leaves are away from the tank *3*, is held closed by a lever *27* which is held down by a pin on the adjacent leaf while the leaves are in filtering position.



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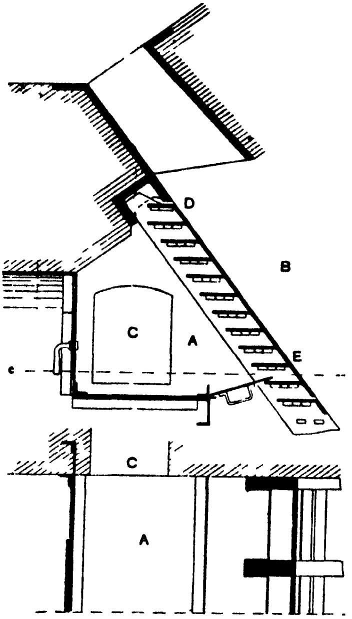
[1] *I.S.J.*, 1922, 274.

[2] See U.S. Pate , 1,291,095; *I.S.J.*. 1919, 471.

HOLLAND.

BAGASSE FURNACE. *Julius R. A. M. Schmutzer*, of Gondang-Pipoero, Jogjakarta, Dutch East Indies. *3621.* May 21st, 1919.

In order to effect a preliminary drying of the bagasse before it actually reaches the grate of the furnace, the radiant heat from the walls is sometimes utilized,[1] but a more gradual desiccation is obtained by withdrawing part of the hot gases from the flue and directing them under the grate to the spot where the wet bagasse is situated.[2] According to the present invention, part of the hot flue gases is drawn through the wet bagasse lying in the top part of the inclined grate, and afterwards into a space in which the pressure is maintained lower than in the fireplace. In the illustration is shown clearly the manner in which this idea is put into operation. The upper of the two drawings depicts a longitudinal section of a furnace provided with an inclined grate; while the lower shows a horizontal section of the same through the line *e f* of the top one. *A* is the space under the grate, which at the point *D* receives the wet bagasse, and at the point *E* delivers it with the required dryness to rest on the grate continued below. By way of the channel *C*, the space *A* is connected with the chimney stack, which by means of the reduced pressure there prevailing draws part of the flue gases from the fireplace *B* through the wet bagasse and through the grate. The desiccation thus produced is very intensive, and can be regulated by means of a damper in the channel *C*. Claim is made for a means of drying bagasse or like wet fuel inside a furnace, according to which part of the combustion gases are conducted through the fuel to be dried and through the top part of the grate into a space in which the pressure is held lower than in the fireplace of the furnace



AUTOMATIC WEIGHING APPARATUS. *Henry V. Adams*, of Djokja, Java. *4820.* March 1st, 1920.

This invention[3] concerns that type of automatic weighing apparatus in which the scale is gradually filled with the powder or liquid under consideration and then tipped over when a certain weight has been reached. Generally matters are so arranged that as soon as one scale-pan tips over to empty, the filling of another commences on the other side of the source of supply of the solid or liquid, each lot of material thus weighed being recorded by an indicating device and the operation thus conducted automatically. However, known forms of such weighing apparatus are stated to suffer from the disadvantage that when they are used for viscous substances a greater or less amount is left behind when the scale-pan reverts to its upright position again, the result being that the weight recorded is not always exact. In this invention an automatic weighing apparatus of simple construction is described in which the defect mentioned has been overcome. Its construction is such that the scale-pans are filled when in a horizontal and emptied when in an inclined position, but are held in both of these positions by catches or suchlike mechanisms capable of being released through the action of electromagnets, the circuit of which is closed under the influence of the weight of the scale-pan when the gross weight is reached in filling, or the tare weight is reached in emptying.

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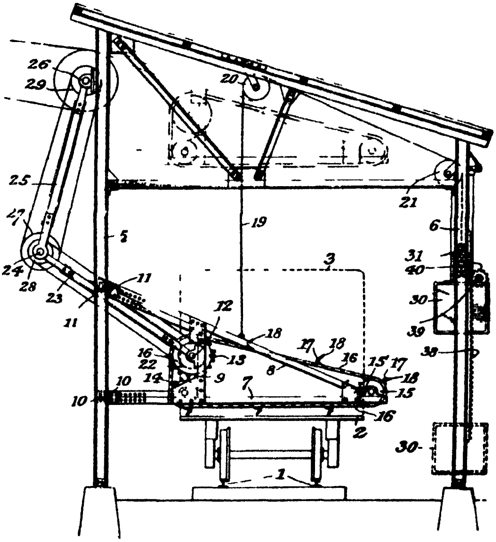
[1] Dutch Patent, 2079. [2] German Patent, 214,800. [3] See also *I.S.J.*, 1922, 193.

UNITED STATES.

Apparatus for unloading the Cane Cars and feeding the Canes on to the Mill Carrier. *Louis D. Gregg (The Gregg Co., Ltd.*, of Hackensack, New Jersey, U.S.A.). *1,332,292.* March 9th, 1920.

With the purpose of obviating manual labour for unloading the cane cars and feeding the stalks on to the endless cane carrier, an apparatus is provided which unloads the cars completely without scattering the canes, while simultaneously placing them at the proper rate on the mill carrier. The lengths of cane may be loaded more or less lengthwise of the car, or indiscriminately (some lengthwise, some crosswise, and some at various angles); and then may be thrown off (sidewise) on to a carrier running parallel with the car, so as to be fed lengthwise into the crushers. The new apparatus (shown in the drawing) comprises a perpendicularly-reciprocable framework suspended so as to be normally free to descend by gravity, which framework carries a depending system of horizontally-arranged and horizontally-propelled feeding-devices or cane-shifting teeth or hooks to constitute the shifting mechanism. Suitable supports for the framework, suitable means for bodily moving it and its shifting mechanism straight up and down, and suitable operating connexions, etc., are supplied. As shown, these supports may comprise two or more inner uprights *5*, and corresponding outer uprights *6*, with suitable cross-braces and roof, constituting in effect a shed.



The perpendicularly-movable framework comprises vertical end-frames, each shaped somewhat like an A lying on its right side, and made up of a horizontal or main member *7*, and above it a diagonal member *8* secured thereto at their meeting outer ends, and also a cross-member or brace *9* whose ends rigidly connect the intermediate portions of the other two members. The framework is suspended by ropes running over pulleys to a counterweight; and each A-frame has the free ends of its two members *7* and *8* provided with guides adapted to bear against and slidably engage the adjacent upright *5*, which serve as vertical guide-ways. Near the top of the framework is journaled the horizontal driving shaft *12*, extending parallel to the railway track, and receiving power as hereinafter described. On this shaft is fastened the driving sprocket *13* of each sprocket system, and in the same vertical plane with each wheel *13*, and below it, are journaled, in horizontal alignment with one another, and near the lower level of the framework, its two other sprocket-wheels *14* and *15*, which may be idlers. Preferably, the distance between said lower wheels *14* and *15* is greater than the width of the car. Around each group (*13-14-15*) passes a suitable endless sprocket-chain *16*. A series of transverse rake bars *17* is carried by one pair of these sprocket systems, and a similar series *17′* by the other pair. Each of these rake-bars in turn carries a number of outwardly projecting teeth or hooks *18*, which depend downward beneath the lower level of the overhanging framework, in position to engage the lengths of the cane upon the car and shift them on to the carrier. The teeth which depend from the lower section of these sprocket systems are aligned in the same horizontal zone, which preferably extends beyond both sides of the car floor *2*. Upon applying power to the driving shaft *12*, the plurality of chains *16* will be propelled, and the depending horizontal ejecting mechanism will be actuated. The framework is suspended by means of two ropes or cables *19*; each secured to it in approximately the line of its centre of gravity, and passing upward over a sheave or a pulley *20* (*20′*) suspended near the top of the shed, and thence off to one side and over another pulley *21* to a counterweight, to assist in raising the framework, and to control the gradual lowering thereof by gravity. This shifting mechanism is propelled in any convenient manner, as by applying power to a sprocket-wheel *22*, fastened on said common driving shaft *12*; and power may be applied to said wheel *22* in any convenient manner.

Evaporating Apparatus for the Concentration of Distillery Slops or Vinasse for the Recovery of Potash. *Henry G. Schwarz*, of Denver, Col., U.S.A. *1,385,499*. July 26th, 1921. (Five figures; three claims.)

Flue gases instead of steam (thus obviating the necessity of extra boilers) are used for the evaporation which takes place in a vessel consisting of upper and lower chambers connected by tubes around which the heating gases circulate. After the gases have heated this first vessel, they pass through a pre-heater for the preliminary heating of the liquid to be concentrated, afterwards escaping to the atmosphere. The vapour from the boiling liquid in the first vessel is fed into the heating space of a second evaporating vessel, and the vapour from this second vessel is similarly used in a third vessel, the apparatus thus constituting a triple effect. Suitable pipes connect the pre-heaters and the first vessel, the second and the third, and the third and the first vessels.

Recovery of Potash from Distillery Slops or Vinasse. *Carl Haner, Jr.* (assignor to the *U.S. Industrial Alcohol Co.*). *1,403,160*. January 10th, 1922. (Two figures; four claims.)

Distillery slops concentrated previously to 20–35° Bé. (36°–64° Brix) is projected upwardly into a tall combustion chamber by means of a spray, thus providing a long path of travel for the spray particles so as to secure complete evaporation and combustion. Thus injected into the furnace, the distillery waste burns within the chamber providing (it is said) its own heat for the evaporation of its volatile constituents, leaving an ash of potassium compounds (chloride, sulphate and carbonate) which can be recovered from beneath the grate bars.

Continuous Sugar (or Massecuite) Washing Machine. *Everett C. Carrick* (assignor to *Nelson A. Lockwood*). *1,367,946*. February 8th, 1921. (Two figures; twelve claims.)

Massecuite or the like is fed upon a segment of the peripheral gauze-covered wall of a revolving drum, and there subjected to a vacuum effect for the removal of its molasses. At this period of the drum's cycle, the deposited sugar may be washed by syrup, water and steam. Later, when the drum reaches a further position in its cycle, the sugar is removed from its filtering wall. Lastly, when the segment of the drum has further revolved, it is brought into communication with a pressure manifold, by means of which the extracted liquid is blown through the peripheral gauze-covered wall, and any clogging material thus removed preparatory to a subsequent deposit of the massecuite or the like. Two of these drums may be used in tandem. Claim 7 reads as follows:—The combination of a drum having a peripheral filtering wall and an internally spaced annular wall with partitioning walls therebetween to provide a circular series of liquid-holding compartments open to said filtering wall; rotating means therefore; a vacuum establishing source; a pressure fluid source; an independent conduit under automatic control leading from each of said sources to each of said compartments and opening to the latter at positions substantially spaced from all of the encompassing walls thereof, which elements function respectively to maintain a substantial vacuum in said compartments during one zone of travel and to expel through the pores of said filtering wall, during a subsequent zone of travel, the filtrate liquid accumulating in said compartments; and means for removing solid deposits from the outer face of said filtering wall, after leaving the vacuum zone and before entering the filtrate expelling zone, substantially as described.

RETORT FOR MAKING ACTIVE (DECOLORIZING) CARBON. *Thorne L. Wheeler*, of New York, U.S.A. *1,413,146.* April 18th, 1922.

An apparatus is described for making active charcoal, comprising a retort having therein a false bottom composed of firebrick, said firebrick being provided with tubular channels therethrough adapted to form when in place continuous longitudinal tubes within the false bottom, one face of the brick having perforations extending to said channels for allowing communications between the channels and the interior of the retorts.

EVAPORATION OF LIQUID OR SEMI-LIQUID SUBSTANCES. *Richard G. Brindle and Amos H. Flint* (assignors to *Corn Products Refining Co.*, of New Jersey, U.S.A.). *1,415,783.* May 9th, 1922.

Claim is made for a method of evaporating a liquid or semi-liquid substance which consists in subjecting the substance to alternative treatments as follows:—First directing it in the form of spray against a collecting surface, together with a draught of a drying gas insufficient in amount to completely evaporate the moisture from the said substance, and then changing the proportion of the liquid substance to the drying gas so that the latter will be capable of drying the substance collected on the said surface.

CANE CRUSHER.[1] *Henry Hurter* (assignor to *Fulton Iron Works Co.*, of St. Louis, Missouri, U.S.A.). *1,309,001.* March 7th, 1922.

GROOVES OF MILL ROLLERS.[2] *Henry Hurter* (assignor to *Fulton Iron Works Co.*, of St. Louis, Missouri, U.S.A.). *1,409,002.* March 7th, 1922.

JAPAN.

DECOLORIZING AGENT MADE FROM CLAY CONTAINING ORGANIC MATTER[3] *K Iida* *37,430.* November 10th, 1920.

Fine clay, as Japanese acid clay as used for decolorizing fish oil (100 parts), is heated at 500 to 600° C. for three hours *in vacuo*, and then boiled with sodium hydroxide (20 to 30 parts) for two hours, filtered and washed with water. Sodium silicate is isolated from the filtrate. The product is boiled with about 30 parts of concentrated sulphuric acid for about two hours, neutralized with acid, and filtered. It is stated the decolorizing power of the product is washed with water, and dried. Sugar juice or syrup is heated with a suitable quantity of this reagent at 80° C. for one hour while agitating, filtered and washed. After use, the preparation is revivified by the treatment already described.

GERMANY.

PRODUCTION OF DECOLORIZING CARBON. *Kurt Eberhardt*, of Heilbron, a.N., Germany. *347,695.* June 11th, 1920.

Residues containing mineral matter and a high percentage of carbon, obtained from nitrogenous or albuminous material, or material containing carbohydrates, by treatment with acids, are distilled in the absence of air yielding, in addition to carbon, also fats and oils, ammonia, hydrocarbons and illuminating gas.

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[1] See also U.K. Patent, 167,074; *I.S.J.*, 1921, 650.

[2] See also U.K. Patent, 172,552; *I.S.J.*, 1922, 164.

[3] *Chemical Abstracts*, 1922, 16, No. 8, 1334.

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	One Month ending June 30th.		Six Months ending June 30th.	
	1921. Tons.	1922. Tons.	1921. Tons.	1922. Tons.
Unrefined Sugars				
Poland	....	....	5,641	....
Germany	....	....	...	....
Netherlands	....	....	398	....
Belgium	....	....	....	..
France	....	. ..	....	....
Czecho-Slovakia		....		....
Java	22	....	22,359	1
Philippine Islands	....	....	....	....
Cuba	13,814	67,339	114,811	494,494
Dutch Guiana	34	549	710	2,362
Hayti and San Domingo	....	....	....	....
Mexico	. ..	....	....	....
Peru	3,929	8,845	58,111	43,656
Brazil	6,955	13,955	38,572	47,532
Mauritius	22,540	26,879	157,018	91,321
British India	....	....	615	1
Straits Settlements	....	....	....	....
British West Indies, British Guiana & British Honduras	17,463	23,606	67,270	67,697
Other Countries	2,215	3,058	30,850	30,925
Total Raw Sugars	**66,971**	**144,230**	**496,354**	**777,989**
Refined Sugars.				
Germany	....	....	1	....
Netherlands	9,129	1,143	51,478	12,455
Belgium	13	194	16,052	2,611
France	5	....	3,012	20
Czecho-Slovakia	11,746	1,210	45,617	24,497
Java	....	....	104	1
United States of America	32,399	45,216	61,771	174,151
Argentine Republic	....	....	....	....
Mauritius	...	....	...	. ..
Other Countries	10,443	17,653	25,178	47,328
Total Refined Sugars	**63,736**	**65,416**	**203,211**	**261,062**
Molasses	4,153	13,001	38,889	53,204
Total Imports	**134,860**	**222,647**	**738,454**	**1,092,255**

EXPORTS.

	Tons.	Tons.	Tons.	Tons
British Refined Sugars.				
Denmark	1	235	1	861
Netherlands	140	304	1,402	1,778
Channel Islands	104	121	711	556
Canada	....	1	....	2
Other Countries	243	8,656	1,538	16,145
	487	9,316	3,652	19,343
Foreign & Colonial Sugars.				
Refined and Candy	70	383	159	1,248
Unrefined	776	4,258	1,304	6,595
Various Mixed in Bond	....	....	....	....
Molasses	39	1	345	899
Total Exports	**1,372**	**13,958**	**5,460**	**28,085**

Weights calculated to the nearest ton.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1922. Tons.	1921. Tons.
Total Receipts, January 1st to June 28th	2,229,310	1,383,140
Deliveries ,, ,,	2,157,024	1,378,474
Meltings by Refiners ,, ,,	2,033,163	1,238,044
Exports of Refined ,, ,,	403,000	116,000
Importers' Stocks, June 28th	72,286	15,718
Total Stocks, June 28th	199,752	184,855
	1921.	1920.
Total Consumption for twelve months	4,107,328	4,084,672

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1919-1920, 1920-1921, AND 1921-1922.

(Tons of 2,240 lbs.)	1919 20. Tons.	1920-21. Tons	1921-22 Tons.
Exports	2,318,956	1,313,434	1,875,214
Stocks	661,762	1,322,313	1,022,255
	2,980,718	2,635,747	2,897,469
Local Consumption	39,700	53,000	62,500
Receipts at Ports to May 31st	3,020,418	2,688,747	2,959,969

Havana, May 31st, 1922. J. GUMA.—L. MEJER.

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR SIX MONTHS ENDING JUNE 30TH, 1920, 1921, AND 1922.

IMPORTS.	1920. Tons.	1921. Tons.	1922. Tons.
Refined	99,091	20,311	261,062
Raw	703,748	496,354	777,989
Molasses	46,397	38,889	53,204
	849,239	555,554	1,092,255

EXPORTS	1920. Tons.	1921. Tons.	1922. Tons.
Refined	767	159	1,248
Raw	3,579	1,304	6,595
Molasses	1,858	345	
	6,204	1,808	8,742

HOME CONSUMPTION.	1920. Tons.	1921. Tons.	1922. Tons.
Refined	117,116	192,476	232,866
Refined (in Bond) in the United Kingdom	385,762	403,464	467,184
Raw	126,232	62,227	84,853
	629,110	658,167	784,903
Less Exports of British Refined	151	3,652	29,343
Total of Sugar	628,959	654,515	
Molasses	19,082	5.819	
Molasses, manufactured (in Bond) in United Kingdom	41,912	23,588	
	689,953	683,922	786,268

STOCKS IN BOND IN THE CUSTOMS WAREHOUSES OR ENTERED TO BE WAREHOUSED AT JUNE 30TH, 1920, 1921, AND 1922.

	1920. Tons.	1921. Tons.	1922. Tons.
Refined in Bond	33,350	14,050	44,300
Foreign Refined	45,400	38,050	41,750
,, Unrefined	349,350	350,100	278,200
	428,100	403,200	364,250

Sugar Market Report.

Our last report was dated 9th June, 1922.

Following a temporary setback after that issue, the upward movement has continued, and all kinds show an advance from quotations last given, although this cannot be attributed to any marked activity on the part of traders here. Day to day requirements have been met by the home refiners, and by arrivals of American granulated on old contracts. In London refined Tate's No. 1 Cubes at 57s. 3d. and London granulated at 50s. 9d. are 2s. and 1s. per cwt. higher respectively, whilst American granulated c.i.f. U.K. is about 1s. dearer, at 22s. 9d. July and 23s. August. Dealings in White Javas c.i.f. London, mostly of a speculative character based on second-hand sales, have taken place up to 21s. 1½d. for July and 21s. for August shipment, and to-day there are sellers at 1½d. per cwt. less. W. I. Crystallized kinds are in moderate demand at 42s. 6d. to 45s. 6d. spot, duty paid, whilst Muscovados are extremely slow of sale and are quoted from 31s. to 38s. according to quality. American granulated spot, duty paid, 49s. 9d. sellers. Offerings of TTDA and SCH fine granulated at 21s. 6d., and Belgian crystals at 20s, f.o.b. for November/December, fail to attract the attention of trade buyers, who are disinclined to look so far ahead.

Movements in the raw market have been of a much more interesting character, reflected in the greater advance in values established. Prices at which Cuban centrifugals were offered to this country crept up under the influence of a strong demand on the American side, until a point was reached where holders of Java Browns deemed it judicious to take a hand. This took the form of offerings to our refiners at competitive rates, with the result that several cargoes were sold c.i.f. U.K. ports at prices ranging from 16s. 10½d. to 17s. 4½d.; Java sellers then increasing their pretensions beyond what refiners were prepared to pay, allowed the running to be taken up by Mauritius crystals, of which some 12,000 tons were done at 21s. 7½d. c.i.f. (say 17s. 4½d. allowing for the preferential duty). Present prices of 18s. 10½d. c.i.f. for Java Browns and 22s. 9d. for Mauritius crystals, are above buyers' ideas. This competition from Eastern sources appears to have had little effect upon Cubans, which have continued to advance steadily and are now quoted 18s. 3d. c.i.f.

The American market has been firm, under the influence of an active trade demand and the pull for raws by refiners, who are said to have melted to their full capacity and are in fact some 30 to 45 days behind with their deliveries. That the movement of sugar has been large is shown in the consumption for the U.S. of some 2,800,000 tons for the six months ending 30th June, but it is also apparent that such a figure must include a certain amount of filling up of invisible supplies, which in the vast area concerned, might easily account for some few hundred thousand tons. For Cuban 96° centrifugals c. & f. New York, up to 3½ cents per lb. has been paid, and this remains the quotation.

The rapid working of the Cuban crop seems to leave no doubt about the total of 3,800,000 tons being reached. The total production to 30th June is given as 3,297,132 tons, exports 2,377,500 tons and stock 844,622 tons, with 15 centrals still grinding.

Under the changed weather conditions which have set in throughout the Continental beet-growing districts, complaints of drought have now ceased and the stand of the crops is generally satisfactory. In Germany an increase on last year may be expected both from the yield and the area sown.

Java continues firm, although India shows no fresh sign of activity, and holders who have taken sugar freely from the Trust at advancing prices, quote White Javas 20s. 9d. c. & f. Calcutta, August/September shipment. Small second-hand lots, however, can be bought at 20s. 3d.

H. H. Hancock & Co.

10 & 11, Mincing Lane,
London, E.C. 3,
July 11th, 1922.

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

Production overtaking Consumption.

A noteworthy change has come over the situation in the world's sugar supply the last six months owing to the greatly increased consumption that has developed. Last January we were faced with a carry-over in the United States and Cuba of some two million tons, and a New York sugar expert then estimated that next January the carry over would be nearly one and a half millions. But Cuba got rid of her surplus stocks with unexpected rapidity during the Spring, partly to European markets but largely in supplying a greatly increased consumption in the States. In the latter, the consumption for the first six months of the year has been no less than 2,893,503 long tons or equal to an annual consumption of 5,787,006 long tons. Incidentally, it is equal to a *per capita* consumption of 120 lbs. per annum. The contrast between then and now is well summed up in *Facts about Sugar*. "The outlook on January 1," says our New York contemporary, "was that sugar would be available to the United States from [her usual] sources[1] to the extent of 600,000 tons a month throughout the year, and the country actually has been taking sugar in excess of this rate, including the amount re-exported. From July 1, however, there is in sight for the remaining six months of the year only 1,750,000 tons or at the rate of about 275,000 tons a month, which is less than the consumption for the corresponding period in any recent year. Including stocks on hand in the United States on July 1, the total available supply from the sources indicated still remains less than 2,100,000 long tons, or less than 300,000 tons a month."

Even the United Kingdom has shared in the general revival of sugar consumption. The quantity consumed by the British Isles during the first six months of the present year amounted to 784,903 tons or at the rate of 1,569,806 tons per annum. As, however, the consumption during the corresponding months of 1921 was only at the rate of 1,316,336 tons per annum and as that for the last three months of the half year under review was at the rate of 1,740,000 tons per annum, we may assume that the pre-war figure, at least, of about 1,750,000 tons is in early prospect again.

All this goes to prove that consumption is overtaking production at an unexpectedly rapid rate and that as a consequence the prices to be obtained for the coming crops will be of a much more remunerative nature and will lead to greater activity. How far they will lead to any great extension of production it is difficult to say, for expansion in the countries most concerned is not easily accomplished in the present financial condition of the capitalistic world; but existing sugar producers ought to see their way more clearly to renew their stock and plant and push on with contemplated extensions; in other words, the market for supplies for the sugar factories ought to benefit greatly from the improved position the rise in the price of sugar has brought and will yet bring along. The 1922-23 season should be assured of a successful issue for cane sugar producers, and since there is no prospect of any rapid recovery of the European beet sugar industry to its former rank of an exporter, cane should continue for some years to come to dominate the market.

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[1] i.e., Cuba, Porto Rico, Hawaii, Louisiana, Philippines and domestic Beet.

Engineering Conditions at Home.

The protracted engineers' strike which prevailed in the Spring in this country achieved nothing but to delay the revival of trade. It was partly the outcome of the refusal of the men to accept a reduction of wages which the employers considered absolutely necessary if competition was to be met, though the main contention was over the question of how far if at all the men could have a say in the management. On this last point the employers stuck to their rights and in the end the men had to abandon their reactionary claim. The matter of wage reduction was referred to further debate between the parties, and in the meantime the men went back to work. The outcome of the wage conference is now a reduction, in instalments, of the weekly wage amounting in all to 16s. 6d. per week. This decision has caused a feeling of discontent amongst the men and a ballot just taken showed a small majority for resistance. The men's leaders do not however think the time or conditions opportune for such action, in view of the futile outcome of the recent long strike, so the wage reduction will undoubtedly take place.

Much as one might be disposed to regret that such wage reductions among a skilled body of men are being effected, there seems no doubt that they are rendered absolutely necessary if British engineers are to remain able to compete with outside rivals in engineering industry. The employers believe that with the wage reduction now being effected trade will revive, especially as many of their customary markets have been holding back orders in the belief or hope that the cost of production would fall further. It does not appear likely that costs will be reduced below the figure allowed for by the pending wage reductions, since these wages will then probably be as low as can be tolerated. There should hence soon be a stability of prices at an economic low level that ought to be taken advantage of by prospective purchasers of engineering supplies. It will be useless expecting a further fall in the near future. If the employers' belief in the revival of trade proves correct, there should be an increase in actual employment as well as more steady employment of existing workers, and this will probably go some way to reconcile the men to accepting the new rates of remuneration. It is to be hoped then that orders will now come in from sugar factories all over the world for the plant and machinery that has been obviously needed for a considerable time. If the present improvement in the price of sugar is maintained, it will be an assisting factor in enabling orders to be placed. What is fairly clear is that little or nothing is likely to be gained by delaying further in the hope that in another few months much lower prices will be obtainable.

The Government's Pledge to the West Indies.

Some anxiety has been felt in British West Indian circles as to the nature of the "pledge" accorded by the Government at home to maintain Imperial preference for a period of at least ten years. It has been feared that the Government's promise would commit no one but themselves, in which case there was no guarantee that a future Government would maintain the undertaking lately given. These fears have led to a correspondence between Sir EDWARD DAVSON on behalf of West Indian interests and the Under-Secretary for the Colonies, Mr. EDWARD WOOD, M.P., in which the former asked to be informed of the precise difference between an "undertaking" and an "agreement." The Government, he pointed out, had refrained from signing any "formal agreement," as it was at first supposed they would do, and had merely announced to the West Indian Governments that they were giving an "undertaking" to maintain the preference for ten years. Sir EDWARD DAVSON also drew attention to a statement in the House of Commons that it was the intention of the Government to "maintain this undertaking as long as they continue to enjoy His Majesty's confidence," and expressed some apprehension lest this amounted to an admission that the undertaking was only guaranteed till the next general election.

Mr. WOOD, replying on behalf of Mr. WINSTON CHURCHILL (Secretary for the Colonies), expressed regret that any misapprehension should be caused by the several pronouncements of the Government on the subject. The object the Government had had in view all along was the creation of confidence in the future of the West Indian sugar industry by giving a definite assurance that British grown sugar would not be deprived of the benefit of the existing preference for a fixed period of years. The Secretary of State therefore welcomes the opportunity of explaining that "to the full extent of their power the Government have, subject always of course to the overriding authority of Parliament, definitely committed the Mother-country to a continuance of preference" for a minimum period of ten years. The Government profess to see no difference between an "agreement" and an "undertaking" in the matter. Both alike, they declare, "constitute a pledge, the value of which depends on the prospect of its being kept as a matter of public faith and not upon the form in which it is cast." . . "There are some constitutional and practical objections to reducing the undertaking to the form of a written agreement." The Government have therefore preferred to use the term "undertaking" as more accurately expressing the substance of their engagement. But in their opinion this in no way detracts from the binding character of their promise. As for the reply made in the House of Commons (above referred to), the particular phraseology was, it appears, no more than an admission that "there is in theory no power in any Government or in any Parliament to bind their successors even by Statute. . . But this difficulty is incidental both to our constitutional theory and to our system of Parliamentary Government. His Majesty's Government cannot however doubt but that their successors, whether they agreed or disagreed with the policy involved, would consider themselves fully bound by the pledge which has been given. There is in their opinion no ground whatever for anticipating any such departure from established precedent and from the honourable traditions of public life in this country as would be involved in a failure to observe an undertaking which has been thus formally given to the West Indian colonies."

Hawaii's Method of meeting the Sugar Crisis.

In our February number[1] we made some notes on the Report of the work of the Experimental Stations under the control of the Hawaii Planters Association. It was recognized that the sugar industry was undergoing a severe crisis, but the writer of the Report assumed a tone of optimism as to the ability of the planters to meet the emergency. To this end there was no despairing folding of hands and *non possumus* attitude on the part of the Station authorities—rather the reverse. "More investigation, more experimentation, more research, leading to higher yields per acre and lower costs per ton," were the watchwords in the Report, and to this end factory matters, which have so long dominated the industry, were frankly laid aside and attention concentrated upon the plantation work, for the simple reason that, because of increasing labour difficulties, the supply of the raw material for the perfected mills was threatened, and thus assumed a dominant position. Super-intensive cultivation was given a prominent place throughout the Report, together with the selection of superior planting material, an intensive study of soil chemistry for gaining an inside knowledge as to the best utilization of the great quantities of artificials used in the islands, and a re-afforesting programme for ameliorating the impending loss of water for irrigation purposes.

In these circumstances the Reports, covering the same period, by the Committee on cultivation, fertilization and irrigation referred to on another page of this number are deserving of somewhat careful study, as they furnish a detailed account of the year's work on the plantations. At first sight, it is true, the optimism of the Experimental Station Report appears to be somewhat discredited, especially as regards the "super-intensive cultivation." We read, for instance, "Cultivation and fertilization are two of the most vital of any of the operations in connexion with cane growing. In cultivation, force of circumstances has led to considerable simplification by having forced us to limit operations to just what we could get at. Off-barring had to be foregone, cultivators were used sparingly, and fields went grassy to the extreme. Hoeing was in arrears and poorly done. The final operation, which used to be a rather elaborate affair of ploughing four times between rows and hilling-up, had to go with running a cultivator twice to a row and a celery hiller after to push the grass under the overhanging cane leaves. We have lived through such times when the treatment would have been considered suicidal, but, from the way the cane has overcome the weeds, it seems as if some of the neglected operations have not been missed."

This provides us with the *motif* underlying the way in which the planters are attacking their problem—setting their house in order. Given such stringency as appears to exist in the availability of labour, where can this best be curtailed? The mere supplanting of man-power by animals or machinery will not suffice, but the very fundamentals of cane cultivation must be dispassionately passed in review. The whole work on the plantation is in the melting pot; and no practice, however sacrosanct by tradition, can be allowed to escape the severest overhauling. As will be seen in the sequel,[2] hilling-up the canes, off-barring the ratoons, stripping the canes before harvesting, the planting of tops, and even the cutting up of mature canes for seed, the method of the application of the customary heavy doses of artificials, have all of them been subject to considerable criticism, and various modifications involving less labour have found local favour as the result of actual experiment during the last year or two. An intensive study of tractors and implements has meanwhile been quietly going on, as evidenced by the number of discarded types constantly observable. A new system of irrigation termed a "modified orchard system" is described at some length by a special officer employed on one estate to study irrigation problems, and the results of a four years' trial at Olaa of a bagasse paper saturated with asphalt for smothering weeds and, presumably, reducing loss of water, are analysed in some detail, with the concluding words: "The results of experiments in the last four years under irrigated conditions are so consistently in favour of mulching as a process for saving labour and increasing yields that it is the belief of the writer that, with modifications according to conditions, it would give satisfactory results if tried elsewhere."

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[1] *I.S.J.*, 1922, pp. 66-69.

[2] See page 422.

Considering that Hawaii is by no means the only sugar cane country where labour difficulties are being felt, there is no doubt that similar work is being attempted in many other parts of the tropics. We read, for instance, that the Colonial Sugar Refining Co. has sent out its inspecting engineer "to the different sugar producing countries for the main purpose of picking up ideas for labour-saving devices, particularly in the direction of agricultural implements." But it is not every body of planters that is sufficiently well organized to tackle the labour problem in such a radical manner. It is often difficult to know where to begin and it is sometimes dangerous to tamper with farm practice which is the resultant of years of past experience. This labour shortage in the tropics is, however, no mere passing phase, and therefore connotes somewhat radical measures if the industry is to maintain its position; and we have therefore drawn marked attention to the method in which the Hawaiian planters are attempting to solve the problem.

The Australian Government Control of Sugar.

A cabled message to the *Times* from its Melbourne correspondent reports that there was lately a vote of censure attempted in the Commonwealth House of Representatives, moved by the Labour and Country parties, on the question of the Government's continued control of the sugar industry; the motion was however defeated by a moderate majority. It is of course the conflicting interests of Queensland against those of the consumers generally and the southern preserve manufacturers that is at issue. The retail price of sugar as fixed by the Government is still 6d. per lb. or 56s. per cwt., while the growers are guaranteed £30 6s. 8d. per ton for their raw sugar. In part the high retail price is said to be maintained in order to recoup the Government for their losses when they had two years ago to buy foreign sugar at the then high world's price. But the Government has neglected, it is said, to furnish a complete statement of its sugar transactions since the agreement made with the growers during the war, and this has added to the discontent. The present agreement made in 1920 expires next year and its renewal is being strongly urged by the sugar industry, while the southern interests would prefer a cheaper sugar at the expense of Queensland. The following are some points adduced by a Brisbane paper in favour of the continued Government support of the industry: The burden of the White Australia policy is practically being borne by the sugar people of Queensland. Sugar production is the only agricultural industry which has proved successful in the tropical north. The sugar industry is the largest wage-payer in the State. The production of sugar in Australia has been a very potent factor in assisting to build up an export trade in manufactured articles, such as Jams, Jellies, and Preserved Milk. Australia now produces all the sugar required either for her home consumption or for the export trade. The value of the Australian output of raw sugar last year was £9,000,000, which is roughly equal to three-fourths of the gross revenue of Queensland for the last financial year.

The sugar industry is easily the most important agricultural industry which Queensland possesses. It is estimated that at least 100,000 persons depend upon it, directly and indirectly. Australia is the only country in the world where cane sugar is produced by white labour.

Position of the Sugar Industry in South Africa.

The *Board of Trade Journal* publishes a brief summary of the Report of the Sugar Enquiry Commission recently presented to the parliament of the Union of South Africa. This Report points out that the great increase in the production of sugar experienced of late years is proof of the prosperity of the industry; and it quotes the following years of output amongst others in this connexion: 1905, 29,795 tons; 1910, 82,000 tons; 1915-16, 133,358 tons; 1919-20, 189,183 tons; 1920-21, 143,730 tons.

If further proof is wanted, add the Commissioners, it is disclosed in the accounts of those companies and most of those planters whose statements were submitted to the Commission. During the post-war years 1919-1921, when the price of sugar, although less than the price abroad, was fixed at high levels, very large profits were made and the opportunity was given of accumulating reserves which ought to have enabled the industry to tide over the lean years, when conditions are reverting to normality. So far as the Commission could learn, however, a considerable portion of the milling section, in a spirit of optimism borne of overflowing exchequers, has committed itself to large expenditures on new mills at high post-war prices, which policy has removed the character of liquidity from its reserves. The industry is now equipped beyond the sugar requirements of South Africa itself, and the probability is that an increasing proportion of the output will have to find a market abroad.

The trouble to-day is that the price realized abroad is much less than that in South Africa, and, even when more normal conditions prevail, it is indubitable that this will continue, although in a less degree. With control removed, the price of sugar in the Union will be governed by the landed price of sugar imported from abroad and the price realized for the surplus output when exported from South Africa must be less by at least the cost of landing it in the country to which it is sent, although the margin between the home price and that realized abroad will probably be much less than it was in the last two seasons.

Unless the South African industry can produce sugar to compete abroad with foreign sugar without having to look to the South African consumer to make up at least some of the difference between the home and export price, the expansion of the industry beyond South African requirements may be a very doubtful blessing to the Union. The utmost protection that could be justified is sufficient to cover the economic costs of producing the sugar necessary for the needs of South Africa, and, in the opinion of the Commission, that is already provided in the existing Customs Tariff.

The United States Sugar Tariff.

Tariff proposals in the United States seem to be running amuck at the bidding of a few extremists. The Emergency Sugar Tariff of 1·60 cents on Cubas and 2·00 cents on non-preferential sugars had been voted to continue by the House of Representatives, but the Senate more recently raised the figures to 1·84 and 2·30 cents respectively, and it would appear that these increases have since been passed by the Senate voting for the Tariff Bill as a whole. This, it is alleged by Willett & Gray, will tax the American public $200,000,000 per annum, half of it being a protection to domestic and Insular sugar producers. But the final say in the matter is not yet; the tariff proposals now go to a Conference Committee and, after adjustments there, will have to be passed again by House and Senate, and then go to the President for signature. It is believed in some quarters that the extreme proposals lately embodied in the Bill (not only as regards sugar) will defeat themselves and produce a more moderate final draft for the President to sign into law.

Patent Rights in Cuba.

Patent rights of the Fulton Iron Works Company, of St. Louis, to the pre-crusher as an invention for the grinding of sugar cane have been signally sustained in Cuba by a recent decree of President ZAYAS, in which an appeal from the decision of the Secretary of Agriculture, Commerce and Labour, refusing to grant the application for a similar patent filed in behalf of the Hooven, Owens, Rentschler Company, is denied.

The decree announcing the decision of President ZAYAS, dated May 25th, 1922, and published in the *Gazeta Oficial* of Cuba on June 9th, reviews at some length the provisions of the Cuban law as bearing upon the case under consideration and sustains the Secretary's decision on the ground that while concession of the patent asked for by the second applicant would not interfere with the first patentee's privilege of seeking redress in the courts for any infringement of rights, the petition must be denied because of the government's duty to protect the rights it has already granted.

The application for a patent in the name of Hooven, Owens, Rentschler Company was filed October 31st, 1919 and on July 3rd, 1920, the expert assigned to investigate reported the existence in the government archives of the record of a Cuban patent already granted to and assigned to the Fulton Iron Works Company, and a United States patent, No. 1,291,095, filed in the name of the Fulton Iron Works Company, by assignment. The Secretary thereupon, in a decision of July 16th, 1920, refused the application. An appeal was taken by the applicants on September 27th, 1920, under the law enacted in 1833 which still governs the granting of patents in Cuba, and was denied in the Presidential decree recently issued. We are indebted to *Facts about Sugar* for this summary of a case which is of considerable interest to patentees.

Sugar Operations in Czecho-Slovakia.

A Department of Overseas report on Czecho-Slovakia states that the State control of sugar, which was introduced during the war, remained in force until the spring of 1921 when it was finally decided to liquidate the Sugar Commission. In order, however, to avoid possible disorganization of the industry and serious losses, all the sugar manufacturers of the Republic combined and formed a syndicate called the Czecho-Slovak Sugar Syndicate. The object of the syndicate is to sell sugar for the common account of all manufacturers, and any losses arising out of sales of sugar abroad are to be borne in equal proportions by all the manufacturers jointly. The present arrangement is that the manufacturers are paid a fixed price for all sugar taken over by the Syndicate, and any losses sustained by sales abroad are borne by the raw sugar factories and refineries mutually according to a definite fixed scale. The beet growers run no risk whatever, but participate in any profits accruing from the sales of sugar abroad to the extent of 43 per cent. The remaining 57 per cent. is divided between the Government (50 per cent.) and the manufacturers (7 per cent.). It was as a syndicate that the sugar industry began the season of 1921-22.

Fifty Years Ago.

From the "Sugar Cane," August, 1872.

This issue of our predecessor contained a note on the origin of the application of animal charcoal to sugar refining. It was an extract from a eulogium on **Payen**, the distinguished French technologist, who had occupied the Chair of Industrial Chemistry at the Conservatoire des Arts-et-Metiers, Paris, and had made many useful contributions to the literature of our subject. It appears that in 1811, **Figuier** had called attention to the decolorizing and purifying properties of animal charcoal, which he demonstrated to be far superior to those of wood charcoal. **Payen**, however, was the first to apply this material to the treatment of sugar juices and syrups on the technical scale, **Derosne** aiding him in overcoming the conservatism of the refiners of that day, and securing patents on methods of application. In the important English patent,[1] taken out in the name of **Charles Derosne**, it is specified that "the charcoal is put in a case in which is a perforated metal diaphragm, about an inch from the bottom, upon which is a coarse linen or woollen cloth. The charcoal reduced to the size of fine gunpowder is very fit for this operation; moistened with a little water, it is laid in layers upon the cloth, each layer being gently pressed till it has come up to the height of fifteen or sixteen inches, more or less. On the top of the charcoal is another metallic perforated diaphragm, upon which is spread another clean linen cloth, upon which the syrup is poured to the height of from four to eight inches. . . . ."

A note appeared in this number regarding "one of the largest copper vacuum pans ever made," which was shipped from Greenock to Liverpool. Its dimensions were 12½ ft. dia. and 13 ft. deep, and it was said to be capable of boiling at one "skippen" 27 tons of moist sugar in 2½ hours.

Some analyses of "centrifugalled concrete" were given in an anonymous article, No. I being described as not being specially prepared, but concreted in the usual way, then broken up, and put in the centrifugal; while No. II was the result of concreting juice which had been filtered through bags, the product thus assuming a "more brilliant or bloomy hue."

	No. I.		No. II.
Cane sugar	98·0	....	92·5
Invert sugar	0·13	....	2·3
Ash	0·4	....	1·0
Moisture	0·7	....	2·6
Other substances, by difference	0·77	....	1·6
Colour by Dutch Standard	14½	....	14½

Lastly, some experiments carried out by the German chemist, **Sostmann**, were described. In the first of these he had gone into the matter of the temperature at which raw beet sugar should be dried, a point which at that time was claiming some attention owing to the fact that quite frequently the figures for the sucrose, reducing sugars, moisture and ash added up to 100 or over, leaving no margin for the organic non-sugar, due doubtless to the errors attached to the determination of the sucrose by polarization, and that of the reducing sugars by Gentèle's potassium ferricyanide process, known to give very uncertain results. **Sostmann** produced data which he claimed proved that more accurate results were obtained by expelling the moisture from the sample of raw sugar by heating at 50°C. *in vacuo*. In another of his experiments here detailed he came to the conclusion that when a solution of sucrose is boiled with calcium or sodium hydroxide no decomposition appears.

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[1] No. 6002 of 1830

Cane versus Beet Sugar for Fruit Preserving and Jam and Jelly Making.

Mr. Geoffrey Fairrie's Misstatements.

By J. P. OGILVIE.

In previous notes[1] attention has been drawn to the inaccuracies made by Mr. Geoffrey Fairrie in certain lectures which during the past few months he has taken upon himself to deliver on the alleged defects of direct consumption sugars. In one of these addresses, delivered at Harrogate, this gentleman dealt with the relative merits of cane versus beet sugars for fruit preserving, and jam and jelly making; and his ideas on the subject are summarized in the following extract:—

> "The old idea that cane sugar is better for sweet making, cooking and preserving, is correct; it is founded on experience. It is a fact, as yet unexplained, that the preserving power of cane sugar is greater than that of beet sugar, *no matter how well the latter is refined.* There is, however, a more important reason for the inferiority of beet sugar. Bone charcoal is the only known material that will completely remove all impurities, colouring matter, and germs from sugar. It is used in filters similar to the domestic type employed to purify drinking water, but on a huge scale. Sugar that has not been filtered through bone charcoal is not properly refined. The semi-refined beet sugar which comes from the Continent has not passed through charcoal; the colouring matter has been bleached but not removed, and the white sugar still contains impurities which can be detected only by the most elaborate chemical analysis; *yet they always cause jams and sweets to go wrong.* The improperly purified foreign beet sugar of pre-war days has now commenced to enter the country again. The consumer's only safeguard against this is to insist upon seeing the bag from which the sugar comes, and if it bears the name of a British refiner, it is suitable for all purposes."

Factors controlling Preserving Value of Sugars.

Regarding this statement (or more properly misstatement), it may be remarked that the value of a cane or beet sugar for preserving[2] depends upon several factors, two of the principal of which are: (1) its freedom from micro-organisms capable of inducing fermentation; and (2) its reaction, which should be neutral, or slightly acid, and not alkaline. It should also be free or almost so from any flavouring or colouring matter which may adversely affect the quality of the particular jam or jelly under preparation.

In regard to the first factor mentioned above, namely freedom from septic micro-organisms, it may be remarked that (contrary to what Mr. Fairrie supposes) it is by no means necessary that animal charcoal should be applied in order to produce a sugar free from harmful yeasts and bacteria. In the manufacture of direct consumption sugars, whether by carbonatation in the beet factory, or by sulphitation in the cane sugar house, a practically sterile juice is obtained as the result of the operation of clarification[3]; and, provided that the product in the centrifugals is washed with steam, a sugar is obtained that should not contain more micro-organisms per grm. than the best refined article. In evidence of this, the fact may be cited that direct consumption sugars are now being used in the jam, fruit preserving, and condensed milk industries with results as satisfactory as those obtained with refined sugars.

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[1] *I.S.J.*, 1922, 230, 288.

[2] In the extract reproduced above, Mr. Fairrie misapplies the term "preserving power" Actually the preserving power of a sugar or syrup depends upon its total content in soluble matter, which may include sucrose, reducing sugars, and soluble non-sugars in the case of a cane or beet sugar, and dextrose, maltose, and malto-dextrins in the case of a starch glucose; that is, the total soluble matter which when mixed with the fruit or fruit juice is capable of giving such a concentrated liquor that the growth of micro-organisms is inhibited.

[3] *I.S.J.*, 1919, 465; 1920, 591.

INFLUENCE OF THE REACTION OF THE SUGAR.

Respecting the second factor mentioned above, namely, the reaction of the sugar, one may say that difficulties in jam and jelly making are nowadays seldom, if ever, to be traced to the presence of alkali salts in the sugar used, though formerly in the case of certain low-grade beet crystals imported in pre-war days from Germany and Austria this was so. It is well recognized that in jam and jelly manufacture the fruit juice used must have a certain acidity,[1] otherwise the pectin on cooling will not "jell." Chemists called upon to investigate matters have sometimes found that the reason why a syrup instead of a jelly has resulted has been the presence in the sugar employed of alkaline salts in sufficient amount to lower the acidity of the fruit juice below the point necessary for the setting of the pectin. However, at the present time, such a condition is hardly likely to be encountered, owing to the high purity of the sugars, cane and beet, now on the market. Other reasons for the refusal of the fruit juice to jell are now more often met with, reasons which quite frequently are in no way connected with the quality of the sugar used, such as the low acidity of the fruit juice, the hydrolysis of the pectin by prolonged boiling, or the use of too high a proportion of syrup.

EVIDENCE OF SUITABILITY OF BEET SUGAR.

Mr. Geoffrey Fairrie's assertion that "the preserving power of cane sugar is greater than that of beet sugar, no matter how well the latter is refined," can only be described as ridiculous. It would be of interest to know what British refiners have to say regarding such a declaration, firms which previous to the war re-melted many thousands of tons of beet sugar, and sold a good proportion of the product to the preserving and confectionery industries of this country.

There is plenty of evidence to show that, provided the sugar does not contain organisms capable of inducing fermentation, is without any appreciably alkaline reaction, and is free from from objectionable colouring or flavouring impurities, it will be suitable for preserving purposes, no matter whether derived from the cane or from the beet.[2] There are now direct consumption as well as refined sugars which fulfil these conditions, and give entirely satisfactory results in the industries concerned.

A year or two ago the point was again demonstrated by the Experiment Station of the State of California in a series of comparative fruit preserving and jelly-making tests carried out by Mr. G. W. SHAW.[3] The cane sugar was a product originating from the Western Sugar Refinery, San Francisco, Cal., and polarized 99·7°; while the beet sugar was not a refined product, but was white granulated made directly from the juice by the American Beet Sugar Co., of Oxnard, Cal., and polarized 99·80. A large number of fruit preserving tests (about 2000) in which the product was canned, packed in boxes, and stored in a rather unfavourable locality showed that only seven made from the cane sugar and six made from the beet sugar had spoiled, and that each defective lot was due to imperfect sealing of the tins. Similarly with the jelly-making tests, the two sugars gave identical results, and in both series the product was as clear as it was possible to be, not the slightest difficulty being experienced in either case in the preparation.

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[1] Dr. NELLIE E. GOLDTHWAITE, of the Research Laboratory of the Department of Household Science, University of Illinois, has determined what this acidity should be for the formation of a good jelly. See *J. Ind. Eng. Chem.*, 1909, 1, 333-340; 1910, 2, 457-462. Also refer to C. H. CAMPBELL, *Ibid.*, 1920, 12, 558-559; *I.S.J.*, 1920, 526.

[2] *Encyclopædia Britannica*, 15, 150a; also *J. Ind. Eng. Chem.*, 2, 457-62.

[3] *I.S.J.*, 1919, 619.

In conclusion, Mr. Shaw made the following statement, here reproduced for the instruction of Mr. Geoffrey Fairrie:—

> "The utter folly of the idea that beet sugar cannot be used for canning purposes is further emphasized by the fact that practically all the sugar used in Germany and France for the purposes of canning and preserving is from the beet, and for many years American refined beet was used without complaint in this country, because the mass of the people were not aware it was derived from the beet."

Beet Sugar Prospects in Korea.

By P. S. GILMAN.[1]

Among the many possibilities for development offered by Korea, the beet sugar industry is one of the most interesting and promising. Furthermore, growth of such an industry on a fairly large scale will be a matter of some importance to the Japanese Empire in general, which has ever in the past been in the position where it has been necessary to import a great portion of the sugar used by the constantly swelling number of her inhabitants. The problem offered by growing consumption was, it is true, met to a considerable extent when Japan acquired Formosa and with great energy and foresight brought forth there a sugar cane industry along modern lines, but since then consumption has grown apace, and there is every reason to believe that it will continue to grow.

At present the per capita consumption of sugar in Japan is about the same as that of Italy, one of the lowest consumers in the world, namely, about 13 lbs. annually, the smallness of which appears in striking degree when compared with the annual per capita consumption of Great Britain and of the United States, which amounts to about 100 lbs.[2] Consumption of sugar has increased in the latter country, especially with the coming of prohibition, and of the 100 lbs. used, about 30 are eaten from the table, while the rest is consumed in various forms of manufactured goods. It is therefore quite plain that as manufacturing industries in Japan increase, her sugar consumption will increase also, and the home supply of this commodity will again become a very pertinent problem for Japanese economists to solve.

Formosa is not in a position to give much assistance beyond what is given already, as that island has almost reached its maximum development as far as sugar cane cultivation is concerned. As Formosa is the only part of the Japanese Empire where it is possible to produce cane on a scale sufficiently large to be of commercial importance, it will be necessary for the Empire to turn to beet sugar manufacture for such expansion of her sugar industry as she may achieve. The principal islands of Japan proper offer but little chance for beet cultivation, as most of the arable areas are of such a nature that it is impossible, or at least impracticable, to obtain in one place fields of the size required for successful sugar beet cultivation. The logical regions for such development are Korea and the island of Hokkaido, and while the latter seems at present to be the most advantageous in this respect, the possibilities offered by Korea are both promising and important.

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[1] Abridged from the *Trans-Pacific.*

[2] Hardly so, the averages for the past six years being about 59 and 81 lbs. respectively. Ed. *I.S.J*

Interest in sugar beet cultivation in Korea is not altogether a new thing, as both the Government and the Dai Nippon Sugar Company have been experimenting for some years with European sugar beet seed. The success encountered in these experiments led eventually to the formation of the Chosen Sugar Company, an offshoot of the Dai Nippon Sugar Company, which ordered a modern plant in 1917; but nothing came of the venture at that time, as it was found necessary to cancel the order, the war making it impossible to obtain a supply of sugar beet seed at the time. When this impediment was finally removed, the initiative was taken promptly both in Hokkaido and in Korea. As a consequence a beet sugar plant was ordered in 1919, to be erected in Heijo, Korea, and it was operated for the first time in 1920, an American firm having supplied the machinery. One of the two plants now existing in Hokkaido began operations at about the same time, the second going into active operation in 1921.

The opening of the beet sugar industry in Japan was not altogether fortunate, owing to the fact that some of the first supply of seed obtained was not of proper quality; some of it, in the case of Hokkaido, proving, in fact, to be mangel seed. In Hokkaido about one-third of the second campaign's crop was lost for this reason, and while Korea did not suffer in anything like similar degree, considerable trouble was encountered there also on account of the unreliable seed factor. This experience served, however, to teach the planters of Japan the paramount importance of having reliable seed, and that now used is of good quality. The yield for the 1921 compaign in Hokkaido was very satisfactory, and it is understood that the same was the case in respect to results in Korea. It should be added that the Korean 1920 crop suffered also from a generally bad summer, an unusually heavy rainfall being injurious to agriculture generally in the peninsula.

The factory in Korea is not as yet working at full capacity. The company, which has now become a regular branch of the Dai Nippon Sugar Company, has some land of its own which it cultivates in beets through its own management, but it concentrates its energy on the mill work and wishes to be able to depend for its supply of beets mainly on Korean farmers. As a matter of fact, it has been common experience the world over that success may not be gained in the beet sugar industry by combining the agricultural and the extraction operations under the same management, and it has been found to be advantageous in all cases to have the plant owners confine their attention to manufacture, with possibly only a small area of land cultivated by the factory owners which may serve as a nucleus and as something which may be depended on with certainty, while independent growers, operating under contracts with the mill owners, are relied upon to furnish by far the greater part of the material for the mills. In Korea, the company expects itself to raise a quantity of beets for some years to come, but it will gradually turn its lands over to Korean farmers, presumably with some proviso to the effect that they must cultivate certain proportions thereof in sugar beets.

The plant at Heijo has capacity for slicing 600 tons of beets a day, this being the size of plant generally used, and it is, in fact, the size used by both the Hokkaido companies. It is thoroughly modern in every respect, although it has not all the appliances for utilizing waste products which are employed in the United States. This plant will normally be able to handle the product of about 7500 acres of beets, as the yield averages at present about 10 tons per acre bringing the total production of the area mentioned up to 75,000 tons of beets per season. The campaign begins about October 1st and should finish during the early part of January, especially in countries where the winter is severe.

Beet Sugar Prospects in Korea.

The sugar beet cultivation of Korea is carried on entirely by Korean farmers, who are not as efficient as are those of Japan, and the Japanese management faces a considerable problem in educating them, although on the whole it has been quite successful. The mill owners contract with the farmers to buy from them the product of such areas as they may be induced to plant in sugar beets, and besides a basic price, various other inducements are offered in shape of various forms of bonuses, such as extra compensation for sugar content above a given figure, prizes for tonnage per acre or appearance of plants, and the like. The Koreans are taking considerable interest in the matter, and are producing results which are surprisingly good, especially when one considers the crude methods by means of which they have been accomplished.

The beet sugar mill in Korea has not as yet arranged to develop the various by-products of the manufacture of sugar which have been found very advantageous in the United States, where, in fact, this branch of the industry has in some cases been developed to the point where some of the by-products promise to become more profitable and important than the sugar. One of the most common of these is dried beet pulp. This pulp easily becomes a nuisance about a plant if it is allowed to accumulate in large quantities, and this fact originally led factory owners to cast about for means of disposing of it. Dried beet pulp is used for stock feed and is already found on the Japanese market, as the Hokkaido beet sugar mills manufacture it. It has met with a considerable degree of success, for while it sells in the United States at about $20 a ton, the Japanese product is selling at from Y60 to Y75 on the Tokyo market at present. It seems inevitable, therefore, that the Korean mill will soon be equipped with dryers, under such favourable circumstances.

The advantages which Korea possesses as a field for beet sugar development, in addition to the fact that it is, with Hokkaido, the only area where Japan may enlarge her sugar production, are numerous, and the area found there which is available and suitable for the purpose is very large. Land used for rice production is of no use for beet planting, as the clayey and wet soil makes harvesting almost impossible, but the great tracts suitable for millet and kaoliang, which are found throughout Korea, offer fine opportunities. It is apparent that under such circumstances the beet sugar industry in Korea is assured of great development, though it is also certain that it will develop along the existing railroad lines before it can penetrate into other districts. However, it may not be expected that great growth, if any at all, will be seen during the first few years, as the unhappy state in which the sugar industry finds itself all over the world effectually forbids expansion anywhere. But as soon as the situation improves and better prices warrant a resumption of expansion, Korea will be certain to be one of the places where the chances offered will be seized upon eagerly and with energy.

In our April issue[1] in an article dealing with the separation of *bagacillo* by the Carter automatic strainer (an apparatus that has proved highly successful in Cuba and elsewhere), a typographical error unfortunately occurred. It was stated that 17,000 lbs. of bagasse were removed in certain trials made with the Carter apparatus from the juice resulting from 042 tons of cane. This cane weight should have read 2800 tons. Adding the 17,000 lbs. of *bagacillo* removed from the cold juice to the 500 tons from the hot defecated juice, this gives the percentage of insoluble matter eliminated from the juice as 0·3 per cent.

Of the 173 sugar beet factories at present in work in Czecho-Slovakia 113 produce raw sugars, 12 are refineries and the remaining 48 are "mixed" factories, states an American Commerce Report.

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[1] *I.S.J.*, 1922, 203.

Concerning Yield Deterioration in the Older Sugar Countries.

By MAURICE BIRD, B.Sc.

In the *International Sugar Journal* for last April[1] Mr. F. I. SCARD has a very interesting letter in which he discusses the susceptibility of the older cane growing countries to the ravages of insect and fungoid pests.

From many years' experience in various sugar countries where I have been engaged in more or less scientific work along the lines of growing and manufacturing sugar, I cannot but conclude that the susceptibility to disease is largely the result of starvation of the cane.

From a practical standpoint I have gone fairly deep into the analysis of soils especially in British Guiana, both as regards their total plant food, and as regards the proportion of this which is available to the growing plant.

Now in Demerara the sugar soils are undoubtedly very rich in their reserves of plant food. Although some are said to have been in cultivation for a century, while the majority have apparently yielded very many harvests of cane, every sample which I have analysed (and my range has been pretty extensive) has shown sufficient *total* plant food to yield successive crops of cane for centuries to come.

When, however, we turn to the *available* plant food in these older soils they often tell a very different story.

To give a striking example of the partial exhaustion of the available plant food of a soil and its renovation, I was called on some years ago to examine some fields which after long cultivation would no longer produce paying crops. On analysis the soil of these fields was found to be so low in available or citric acid soluble potash, that in calculating this to a depth of 12 inches, and comparing the quantity thus found with the potash in an average crop of cane, it was evident that the roots of the cane would have to find, and assimilate, one seventh of the total weight of the available potash existing at the time of analysis in order to produce a fair crop.

This seemed an unreasonable demand on the foraging power of the cane roots when the limited soil area with which these come in contact was considered, and so applications of potash was prescribed. Subsequently the manager of the estate remarked to me; "I am glad you recommended potash for those fields, for they are not only growing good cane now, but are free from marasmius." I had not known before that the cane was diseased; only that the crop was very short.

Again I was called to another estate which had what was thought to be "marasmius" on the half of one field and the whole of another. Samples were taken in a dozen places in each field. They showed abundance of plant food except as regarded phosphoric acid in the available form; this was extremely deficient where the disease existed, the total quantity being barely sufficient to give the phosphoric acid for *three* crops if every pound to a depth of 12 inches were utilized; while, on the half of the field where the cane was healthy, there was abundance of every form of plant food in the available form, including phosphoric acid. Indeed of this element I calculated sufficient available to produce *thirty-three* crops of average yielding cane.

Another estate to which I am consulting chemist called on me last year to prescribe for 37 fields, on all of which the crop was more or less deficient. On analysing their soils, every field, with a single exception, showed a low content of either available lime or available phosphoric acid; while in the case of the single exception noted this field had received phosphoric acid just before being sampled.

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[1] Page 208.

Another estate for which my predecessor and I made for years numerous soil analyses, from the standpoint of available plant food, and whose management manured more or less according to the soil requirements so ascertained, gave for 8 years an average yield of 2·69 tons sugar per acre, results far above the average for British Guiana.

There seems little doubt then that in many old soils the plant food is becoming available more slowly than is demanded by the growing cane, and that unless artificial manure of the proper form is applied the land will yield an increasingly diminishing crop and like a starved animal will become more and more vulnerable to insect or fungoid pests. The important thing is to have a correct analysis of the soil, since, for instance, if this requires potash it is money thrown away to apply phosphoric acid.

Correct analyses and their proper interpretation entail painstaking care, but these will be well repaid by results. If, on the other hand, this demand of nature is unheeded, I believe abandonment of these older sugar lands will eventually become imperative.

It may not be out of place here to mention a very peculiar condition, which exists on many of the coastal estates of British Guiana, the importance of which is only now beginning to be recognized and which indirectly adds considerably to the exhaustion of the soil. Owing to the tenacity of the stiff clay which predominates, the internal drainage of the fields is very incomplete with ordinary drainage methods, with the result that the water underlying the surface of the soil becomes each year more heavily charged with the soluble ingredients of the decomposing soil. This soluble mineral matter sometimes amounts to as much as one per cent of the soil water. Since, in this compound alkaline carbonates of soda and magnesia predominate, considerable silica is dissolved from the soil, which entering the roots of the cane, is, I think, responsible for much of the low purity so characteristic of Demerara juice, as well as hindering a complete extraction of sugar in the factory.

All this means of course a greater tonnage of cane to make a ton of sugar, or in other words, a more rapid exhaustion of the available plant food in the soil and consequently a still greater need of a scientific scheme, such as I have outlined, for maintaining a good reserve of all the elements of this same available plant food in the soil.

As Mr. Scard says, it is to be *hoped* that others, with long experience in cane cultivation, will further ventilate, and help to coalesce into active shape, this question of soil renovation, which would appear to be one of paramount importance.

Canefield-Berbice, British Guiana.
June 30th, 1922.

We are sorry to announce the death of Mr. Moriz Weinrich, well known as an inventor in the sugar industry, on July 15th at Rosendale, New York, at the age of 76. Among the processes elaborated by him at different times are the following: Method of defecating juice while still in the cane so as to retain the scums in the bagasse[1]; revivification of spent animal charcoal by burning off the organic matter, impregnating with gelatin, and reburning[2]; centrifugal for affining or washing raw sugar[3]; defecation of raw cane sugar with lime while in the state of a magma (so-called "dry lime process")[4]; rotary apparatus for the revivification and decarbonization of bonechar[5]; stationary apparatus for the revivification of bonechar[6]; manufacture of a granular decolorizing carbon from molasses[7]; and a method of revivifying this granular decolorizing carbon[8].

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[1] U.S. Patent, 455, 675 of 1891. [2] U.S. Patent, 509, 460 of 1893.

[3] U.K. Patents, 1870 of 1874 and 3505 of 1882.

[4] U.K. Patents, 1576 of 1914; U.S. Patent, 1,084,772 of 1914.

[5] U.K. Patent, 6347 of 1913; U.S. Patent, 1,121,429.

[6] U.K. Patent, 7219 of 1916; U.S. Patent, 1,184,398. [7] U.K. Patent, 132,164; U.S. Patent, 1,308,826.

[8] Patents applied for.

The 1921 Java Sugar Crop.

By H. C. PRINSEN GEERLIGS, Ph.D.

For the 1921 season 183 sugar factories worked in Java, these being exactly the same establishments as were active in the previous year. They had planted 159,474 hectares, or 394,060 acres, with cane, and they harvested from that area 14,939,679 tons of cane, from which quantity 1,658,032 tons of sugar were extracted. The area under cane was only slightly larger than in 1920 and has reverted once more to the same figure as in 1917, when it was 396,440 acres. We have calculated the particulars as to tonnage of cane per acre, number of active factories, output of sugar per acre, per 100 cane and in total, from the figures given in *Archief voor de Java Suiker Industrie* by J. H. RITMAN, and they are as follows.

The crop of 1921 was grown under favourable conditions, the dry and rainy spells being evenly divided during the growing period, while excellent dry weather reigned during the grinding season. No disturbances or troubles were encountered, so that the reaping of the crop was able to proceed without serious interruption.

The tonnage of cane to the acre over the whole island amounted to 37·89 tons, or slightly more than in 1921. Although this figure is nothing to boast of, yet it may be considered as satisfactory. The residency of Besoeki heads the list again with 42·92 tons of cane to the acre, closely followed by Semarang with 39·90. Djokdjakarta and Soerakarta, which in previous years were among the highest returns, have fallen in the list this time and are even surpassed by the residency of Cheribon.

I.—CANE CROP.

Residencies and Totals.	Number of Factories in Operation.	Land under Cane. Hectares.	Land under Cane. Acres.	Cane Harvested. Tons.	Cane Harvested. Tons per acre.	Cane Harvested. Kilograms per hectare.
Cheribon	12	9,449	23,348	868,142	37.16	93,297
Pekalongan	18	16,698	41,261	1,629,202	39.56	99,802
Banjoemas and Kedoe	8	8,502	21,008	738,051	35.12	88,162
Djokdjakarta	17	14,690	36,299	1,330,085	36.29	91,121
Soerakarta	15	13,464	33,269	1,175,861	35,32	88,684
Semarang	12	9,703	23,976	957,332	39.90	100,172
Madioen	6	6,807	16,820	617,769	36.68	92,079
Kediri	21	22,928	56,655	2,239,565	39.52	99,215
Soerabaja	36	27,394	67,691	2,573,092	38.03	95,473
Pasoeroean	29	23,277	57,518	2,114,623	36.78	92,340
Besoeki	9	6,562	16,215	695,957	42.92	107,744
Total, **1921**	**183**	**159,474**	**394,060**	**14,939,679**	**37.89**	**95,125**
1920	183	156,069	385,647	14,398,238	37.34	93,732
1919	179	137,655	340,138	13,075,128	38.10	96,517
1918	186	163,071	402,943	15,637,342	38.44	97,387
1917	185	160,439	396,440	17,079,303	43.09	108,179
1916	186	155,165	385,290	15,878,300	41.11	103,218
1915	186	151,165	373,500	14,189,000	37.97	96,385
1914	186	147,465	366,000	14,901,000	40.87	102,009
1913	190	145,321	359,200	14,951,000	41.63	104,534
1912	184	140,303	346,800	14,374,300	41.53	104,263

Tons of 2240 lbs.

II.—SUGAR EXTRACTED.

Residencies and Averages	Kilograms per hectare	Lbs. per acre.	On 100 Cane	Yearly maximum output of any single factory. Kilograms per hectare.	Lbs. per acre.
Cheribon	10,305	9,133	11.06	13,925	12,342
Pekalongan	10,598	9,403	10.67	14,064	12,465
Banjoemas and Kedoe	9,749	8,641	11.06	11,410	10,113
Djokdjakarta	11,281	9,778	12.36	17,911	15,875
Soerakarta	11,220	9,934	12.65	13,455	11,925
Semarang	11,155	9,887	11.08	14,073	12,473
Madioen	10,100	8,952	10.96	12,915	11,447
Kediri	11,041	9,786	11,13	14,490	12,842
Soerabaja	10,390	9,209	10.88	15,187	13,461
Pasoeroean	9,694	8,592	10.96	14,177	12,565
Besoeki	10,477	9,286	9.70	10,626	9,418
Average, **1921**	**10,517**	**9,321**	**11.04**	**17,911**	**15,875**
" 1920	9,892	8,826	10.55	15,178	13,540
" 1919	9,706	8,657	10.06	14,639	13,057
" 1918	10,904	9,723	11.19	15,996	14,265
" 1917	11,382	10,117	10.50	16,415	14,696
" 1916	10,355	9,238	10.03	15,300	13,650
" 1915	8,729	7,788	9.15	12,941	11,546
" 1914	9,526	8,495	9.28	14,125	12,602
" 1913	10,087	9,110	9 65	14,708	13,122
" 1912	10,026	8,910	9.63	13,490	12,034

III.—SUGAR PRODUCTION IN TONS.

Residencies and Totals.	First Sugars.	After Products.	Total Production. After products as 4 3	Solidified Molasses.
Cheribon	93,358	4,201	96,509	950
Pekalongan	171,319	3,880	174,229	9,497
Banjoemas and Kedoe	81,516	1,170	82,394	4,032
Djokdjakarta	161,063	2,272	562,767	—
Soerakarta	146,509	2,608	148,416	—
Semarang	105,425	1,535	106,576	1,704
Madioen	67,760	704	68,288	1,712
Kediri	245,680	4,658	249,195	22,171
Soerabaja	273,154	8,083	279,217	15,952
Pasoeroean	219,393	4,252	222,583	14,378
Besoeki	66,890	1,257	67,858	4,446
Total, **1921**	**1,632,067**	**34,620**	**1,658,032**	**74,892**
" **1920**	1,497,244	30,060	1,519,562	164,459
" **1919**	1,297,320	23,977	1,315,158	96,303
" **1918**	1,714,833	47,992	1,750,197	18,511
" **1917**	1,779,654	22,682	1,793,415	49,870
" **1916**	1,579,670	32,300	1,604,154	85,749
" **1915**	1,273,190	35,312	1,298,307	127,543
" **1914**	1,305,246	100,061	1,382,825	94,765
" **1913**	1,381,673	125,002	1,442,884	65,756
" **1912**	1,338,607	61,686	1,384,242	75,510

Tons of 2240 lbs.

IV.—Subdivision of the Crop in Percentages according to Assortments.

Residencies and Averages	White Plantation Sugar. First running.	White Plantation Sugar. Second running.	Channel Assortment Refining Crystals, 98° pol.	Refining Crystals, 96.5° pol.	After products.	Total.
Cheribon	46.6	4.1	24.7	20 2	4.4	100
Pekalongan	68.8	3.2	11.9	14.0	2.1	100
Banjoemas and Kedoe	—	—	61.0	37.6	1.4	100
Djokdjakarta	75.0	0.6	19.6	3.4	1.4	100
Soerakarta	86.3	1.5	9.9	—	2.3	100
Semarang	45.7	2.0	44.1	6.7	1.5	100
Madioen	84.6	1.6	12.8	—	1.0	100
Kediri	57.6	0.2	26.4	13.9	1.9	100
Soerabaja	60.1	1.1	20.9	15.6	2.3	100
Pasoeroean	23.1	—	43.7	31.2	2.0	100
Besoeki	—	—	69.0	29.1	1.9	100
Average, 1921	**53.42**	**0.12**	**28.05**	**15.33**	**3.08**	**100**
„ 1920	51.71	0.83	30.41	15.08	1.97	100
„ 1919	49.7	2.1	23.1	23.3	1.8	100
„ 1918	45.9	3.2	27.0	21.0	2.9	100
„ 1917	50.3	1.9	40.6	6.2	1.0	100
„ 1916	48.1	2.9	37.3	9.7	2.9	100
„ 1915	43.8	4.2	34.9	14.1	3.0	100
„ 1914	40.3	4.0	32.3	15.7	7.7	100
„ 1913	32.9	6.8	30.0	20.9	9.4	100
„ 1912	33.6	5.6	29.9	26.2	6.7	100

The percentage of sugar extracted on 100 parts of cane was very high, averaging 11·04 per cent., or only slightly under the best year in the last decade, viz., 1918, when the percentage was 11·19. In this respect Soerakarta and Djokdjakarta are foremost with 12·65 and 12·36 per cent. respectively, which gives the sugar production per acre of these two residencies the highest position of all with 9998 and 9887 lbs. of sugar to the acre respectively. Besoeki with the highest return of cane, shows the smallest yield per 100 cane, viz., 9·70 per cent., which reduces the yield of sugar per acre of that residency to below the general average of the whole island.

The maximum yield of sugar per acre during the entire grinding season in a single factory is very high this year and reaches the unprecedented figure of 15,875 lbs. (7 long tons) on the estate of Gondang Lipoeroe in the residency of Djokdjakarta. This fact is the more gratifying, in that the Gondang Lipoeroe

V.—Percentual Composition of the Cane Plantings for the Crop of—

Variety	1913	1914	1915	1916	1917	1918	1919	1920	1921
B. 247	54	58	57	54	48	41	29	26	20½
P.O.J. 100	32	29	30	30	31	28	16	10	6½
Cheribon	8	6	5	5	4	3	1	1	½
P.O.J. 213	1	1	1	1	1	1	—	—	½
E.K. 2	—	1	1	2	4	4	6	6	6½
E.K. 28	—	—	—	—	2	6	23	32	39
F. 90	—	—	—	1	2	4	4	3	3
D.I. 52	—	—	—	—	1	4	13	14	15
Tjep. 24	—	—	—	—	—	2	1	1	1
S.W. 3	—	—	—	—	—	1	1	2	2
Various	5	5	6	7	7	6	6	5	5½
Total	100	100	100	100	100	100	100	100	100

estate is the very place from which the two celebrated E.K. seedlings originated a number of years ago. The manager of that estate has grown a great many new cane varieties, which he has distinguished from others by giving them his initials. According to Table No. V two of them have been greatly extended over the island and it is on the estate for the soil of which they are best adapted, that the record yield has been attained in 1921.

The total sugar production has been 1,658,032 tons, of which a little over half the amount consisted of white plantation sugar. About one-third consisted of grey raw sugar, sold on the basis of 98° polarization and about one-sixth of brown refining crystals, basis 96·5° polarization. The total amount of these sugars was 1,632,067 tons and in addition a quantity of 34,620 tons of after-products was turned out. These after-products have been incorporated into the total figure calculated at the ratio of 4 parts of after-products to 3 parts of first sugar. Finally a quantity of 74,892 tons of solidified molasses has been produced, or much less than during 1920.

VI—FACTORY RESULTS DURING THE LAST DECADE.

CANE—	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921
Sucrose	12.35	12.54	11.91	11.63	12.42	12.82	13.63	12.38	12.94	13.41
Fibre	12.17	12.40	12.61	13.26	13.14	13.02	12.99	13.01	12.98	12.98
BAGASSE—										
Sucrose	4.47	4.45	4.21	4.11	4.00	4.10	4.34	4.03	4.07	4.12
Moisture	46.52	46.52	46.27	46.64	46.97	46.82	47.22	47.01	46.76	46.43
Sugar extraction by mills	90.8	90.8	90.4	91.9	91.1	92.3	92.1	92.0	92.5	92.5
Sucrose in filter-press cakes	6.96	7.00	6.72	7.97	4.51	4.15	4.36	3.70	3.75	3.81
Sucrose in juice on 100 canes	11.21	11.38	10.77	10.69	11.32	11.83	12.55	11.39	11.97	12.41
Purity in raw juice	81.47	80.95	80.39	82.00	84.41	85.80	86.50	83.7	85.4	85.3
Purity of final molasses	33.00	32.92	32.70	32.45	32.4	32.6	33.1	32.1	32.2	32.4
Calculated available sugar	10.44	10.33	9.94	10.00	10.80	11.40	12.17	10.60	11.31	11.73
Sugar extracted on 100 canes	10.21	10.00	9.76	9.65	10.42	11.00	11.68	10.44	11.13	11.51
SUCROSE TURNED OUT ON 100—										
Cane	9.80	9.75	9.33	9.18	10.06	10.48	11.27	10.12	10.64	11.00
Sucrose in cane	79.35	77.75	78.34	79.20	81.00	81.75	82.61	81.66	82.23	82.76
Sucrose in juice	87.42	85.77	86.63	86.40	88.90	88.58	89.80	88.85	88.90	88.6
SUCROSE LOST ON 100—										
Cane	2.55	2.79	2.58	2.45	2.36	2.34	2.36	2.26	2.30	2.41
Sucrose in cane	20.65	22.25	21.66	20.87	19.00	18.25	17.39	18.34	17.77	18.12
Sucrose in juice	12.58	14.23	13.37	13.60	11.10	11.42	10.20	11.15	11.10	11.40
LOST IN BAGASSE ON 100—										
Cane	1.14	1.16	1.14	0.94	1.10	0.99	1.08	0.99	0.97	1.00
Sucrose in cane	9.23	9.25	9.57	8.08	8.86	7.72	7.92	7.99	7.50	7.46
LOST IN FILTER-CAKES ON 100—										
Cane	0.10	0.11	0.13	0.12	0.10	0.09	0.10	0.09	0.10	0.10
Sucrose in cane	0.82	0.86	1.09	1.03	0.80	0.74	0.73	0.73	0.77	0.75
Sucrose in juice	0.89	0.98	1.21	1.12	0.88	0.80	0.80	0.79	0.80	0.81
LOST IN MOLASSES ON 100—										
Cane	1.16	1.22	1.01	1.09	0.85	0.91	0.94	0.90	0.93	1.01
Sucrose in cane	9.39	9.73	8.48	9.38	6.84	7.11	6.95	7.27	7.11	7.16
Sucrose in juice	10.35	10.74	9.35	10.20	7.59	7.70	7.50	7.90	7.80	7.74
UNACCOUNTABLE LOSS ON 100—										
Cane	0.15	0.30	0.30	0.30	0.36	0.35	0.24	0.28	0.30	0.30
Sucrose in cane	1.21	2.41	2.52	2.38	2.50	2.68	2.17	2.35	2.39	2.75
Sucrose in juice	1.32	2.51	2.81	2.29	2.66	2.92	2.54	2.46	2.50	2.86

The percentages of white and brown sugars, made in the different residencies, do not show any important change, as compared with previous years. It appears that conditions are settled by now and manufacturers are sticking to their methods and do not want to make further changes in their mode of working.

The factory results (Table VI) may be judged from the yearly figures issued regularly by the Chemical Department of the Java Experimental Station. These contain the data, covering the whole factory work during the year of 146 sugar factories only, and therefore the data on sugar turned out on 100 cane do not agree with those of Table II, which contains the average results from a total of 183 sugar houses.

The Sugar Content of the Cane was very high in 1921, only remaining very little under the record average of 1918. The maximum is reported by Bantool with 15·70 and the minimum by Krian with 11·48.

The Fibre Content of the Cane works out exactly the same as in the previous year and very similar to that of the years immediately preceding. The Bagoe estate claims the maximum figure of 18·18 and Brangkal the minimum with 10·74.

The Sugar Content of 100 Bagasse is slightly higher than in 1921, which coincides with the higher sugar content of the cane from which it has come. The maximum sugar content belongs to Padokan with 6·08 and the minimum to Pohdjedjer with 2·56.

The Moisture on 100 Bagasse is again lower than in the year 1920, but, on the whole, has not changed very much in the decade under review. It appears that all the trouble taken during the last twenty years to increase the efficiency of the mills and to improve the work done in them, has not had the effect of diminishing the moisture content of the final bagasse. The maximum was attained at Perning with 50·73 and the minimum at Badang bendo with 41·75.

The Sugar Extraction by Mills is just the same as in 1920, viz., 92·5, which is about the figure of the last few years.

The Sugar lost in Bagasse for 100 of Cane is only a little higher than in 1920, in spite of the lower sugar content of the cane in the year under consideration. We must observe once more that this result is rather disappointing and that we had expected a better outcome from the shifting of mills, the erecting of cutters, shredders, crushers, etc., etc.

The Sugar on 100 of Filter-press Cakes is about the same as in 1920, but it has undergone a large and pleasing reduction during the last few years. The average is 5·27 for factories working with defecation, 7·36 for those clarifying the juice with sulphitation and 3·81 for those which apply the carbonatation system. The maximum for the first mentioned two methods is claimed by Langsee with 12·42 and for the carbonatation by Djatiwangi with 2·84, while the minima are 0·49 at Poerwordejo and 0·11 at Sewoegaloer respectively.

Loss of Sugar in Filter-cake per 100 of Cane was on an average 0·10, being 0·10 for defecation, 0·11 for sulphitation and 0·06 for carbonatation.

The purity of the *Raw Juice* amounted to 85·3 on an average and is therefore very satisfactory; the maximum is reported from Beran and Medarie with 90 and the minimum from Koning Willem II with 76·7.

The purity of the *Final Molasses* is 32·4 or similar to that experienced of late years. Here also it appears that the maximum results have been attained long ago and that no great improvements are being made in connexion with the better exhaustion of the final molasses. This is all the stranger in that during the last few years many public announcements in the press have appeared which promised a very greatly improved reduction of the quotient of purity of the final molasses by new methods. Soemberredjo reports the maximum figure of 35·8, while Krian is responsible for the minimum of 29·2; the purity figures from 146 factories are thus within rather narrow limits; a proof that no further great improvement can be hoped for in this direction.

The averages for the ratio, *Sucrose*: *Brix*, are in 1921 for defecation 36·2, for sulphitation 36·1 and for carbonatation 36·2. For the ratio, *Polarization*: *Brix*, they are 32·2, 32·4 and 32·4 respectively. This again shows that the method of clarification has no influence on the degree of exhaustion of the molasses, provided the work be well done. The average loss in molasses per 100 of cane is about

1 per cent. or the same as in previous years. It is identical with that for bagasse, and we fear that we shall have to accept these coincidences as inevitable.

The Sucrose in Juice on 100 Cane averaged 12·41, a very high figure which was only exceeded in the year 1918. We note the maximum at Dinoyo with 14·60 and the minimum at Bagoe with 10·14.

Calculated Available Sugar stands in direct proportion to the amount of sucrose extracted on 100 cane in juice and the quotient of purity of the latter. The average for the whole year and the whole island was 11·73; the highest average comes from Dinoyo with 13·98, the lowest from Bagoe with 8·98, a result which was to be expected. The real amount of sugar extracted, expressed in "standard" refining crystals of 96·5 polarization and 0·7 water content, was 11·51. This is only 0·22 per cent. under the calculated value, which is very satisfactory if one bears in mind that the calculated figure is not far from the maximum possible, if no loss has been suffered through spilling, leaking, boiling-over, sourness, or theft. The best returns are from Dinoyo and the lowest from Bagoe, as could be expected from the foregoing observations.

VII.—SUGAR EXPORTS 1ST APRIL—31ST MARCH. TONS OF 2240 LBS.

DESTINATION.	1917-18.	1918-19.	1919-20.	1920-21.	1921-22.
Netherlands	—	—	21,283	9,804	10,222
Belgium	—	—	—	7,396	—
United Kingdom	317,955	142,547	119,528	50,642	9,124
France	34,468	55,536	41,636	10,013	10,124
Germany	—	—	—	—	104
Switzerland	—	6,528	—	—	—
Russia and Finland	—	2,958	1,414	10,922	4,000
Denmark	—	—	2,370	—	681
Sweden	—	—	14,522	27,807	—
Norway	19,780	44,272	50,152	31,008	—
Italy	—	5,495	45,956	18,166	33,502
Portugal	—	—	—	1,000	—
Spain	—	—	6,919	3,004	—
Greece	11,793	5,162	8,239	5,907	5,875
Rumania	—	—	3,921	3,070	3,756
Servia	—	—	—	—	951
Turkey	—	—	23,231	2,174	9,049
Egypt	—	2,844	—	—	4,810
Suez	18,231	28,870	11,083	11,843	8,018
Port Said, f.o.	12,205	19,438	56,041	353,630	48,626
Argentina	—	5,200	—	—	—
United States	—	7,423	—	237,162	300
Vancouver	3,514	17,656	2,953	—	5,020
Singapore	157,736	163,230	64,568	41,450	70,041
China	2,314	31,961	3,525	3,765	32,638
Hong Kong	163,654	308,792	184,422	171,398	319,126
Japan & Formosa	90,802	439,396	272,187	94,473	353,787
British India	336,736	343,480	336,000	212,562	625,909
Australia	—	30,000	82,718	63,362	5,447
Siam	21,397	3,612	3,428	2,385	3,565
Other Countries	141	100	3,152	644	20
Total	1,190,726	1,664,801	1,356,338	1,356,338	1,564,695

The average ratio between calculated available sugar and the quantity actually turned out, both calculated to the same standard, was for all factories 98·1. For the defecation factories it was 98·9, for the sulphitation ones 97·3, and for the carbonatation ones 98·1, thus showing no great divergences. The maximum ratio is reported by Bodjong and Pandji with 102·8 and the minimum by Poerwoasri with 90·7.

The unaccountable loss is very low again, being on an average 0·30 on 100 cane. Since therein are combined all conceivable losses, save those in bagasse, filter-press cakes and molasses, this figure does not give any cause for complaint, and it agrees wonderfully well with the calculated difference between sugar estimated to be obtained and the amount actually recovered, which was 0·22 on 100 cane.

The general conclusion derived from the figures reviewed above is, that the work done in the factories during 1921 has been well arranged, well conducted, and well supervised.

SALES AND EXPORTS.

Once more about 90 per cent. of the whole crop has been sold through the intermediary of the United Java Sugar Producers, which sold altogether 24 million piculs (say 1,459,000 long tons), sub-divided as follows:—

	PICULS.
White plantation sugar, first runnings	13,459,549
White plantation, second runnings	160,350
Refining crystals, basis 98°	6,596,563
Refining crystals, basis 96·5°	3,437,300
Molasses sugar	334,100
Sack sugar	9,000
Total	23,996,862

The sales by that body started as early as June, 1920, with the sale of 400,000 piculs of white sugar at 50 guilders per picul and 500,000 piculs of grey refining crystals at 48 guilders. One of the buyers, however, having contracted for 200,000 piculs, failed before the sugar could be delivered, so that payment could not be made. In order to prevent deterioration of the sugar during the ensuing lawsuit, the United Java Sugar Producers took fresh charge of that sugar and resold it afterwards at prices around 12 guilders.

No further sales were reported till the end of December. From that time onwards till the end of February the price of sugar was 20 guilders for whites, 19 for greys, and 18¾ for the brown refining sugar, and down to the end of February the sales were as follows:—

	PICULS.
White sugar, first runnings	4,996,075
White sugar, second runnings	61,250
Refining crystals, basis 98°	1,769,100
Refining crystals, basis 96·5°	1,641,750
Total	8,468,175

During March, April, May, and June, 1921, no transactions took place, but between 1st July and the following October the rest of the crop was sold at prices of 12 to 14 guilders for whites, 10 to 12 for greys, and 9¾ to 11½ for browns. After October no sugar was in stock in first hands.

The average price for the sugar under the control of the United Java Sugar Producers has been 16·10 guilders for the whites, 15·78 for the greys, and 14·72 for the browns.

We assume the price made by the independent sellers to be the same, and in that case the average price of the 1921 Java sugar crop may be put down at 15·80 guilders per picul, equivalent to £1 1s. 8d. per cwt. The total value of the crop may be reckoned at 426 million guilders or 35 million pounds sterling.

About 130,000 tons are considered to be consumed in the Archipelago, and all of the rest has been exported before the advent of the new crop to the destinations mentioned in Table VII.

The American Tariff and the Price of Sugar.[1]

A Lesson in Economics.

In what may be termed popular discussions of the tariff, and particularly in statements designed to make the tariff unpopular, attempts are repeatedly made to express in dollars and cents the effect of import duties upon prices. This line of argument is particularly favoured by the opponents of a protective or competitive tariff on sugar. A claim widely circulated by those engaged in the propaganda for a reduction of the tariff has been that the increased rate of duty put into effect last year on Cuban sugar imported into the United States added $162,000,000 a year to the amount paid by consumers. Some other statistician figured out that the sugar tariff cost each consumer seventy cents a year, which would amount to approximately $75,000,000 for the whole country, while a recent pamphlet advocating a reduction in the sugar tariff places its annual cost for the whole country at $60,000,000.

In dealing with a subject of this kind a little history is more illuminating than reams of theoretical argument. In the past thirty years there have been five important changes in the tariff on imported sugar. The first of these was contained in the Wilson Tariff Act, which laid an impost of 40 per cent. ad valorem on imported sugar which had been admitted free of duty under the preceding McKinley law. The Wilson law was adopted in 1894, and it is noteworthy that the average wholesale price of refined sugar, which had been 4·84 cents a lb. during 1893, and 4·12 cents in 1894, was 4·15 cents in 1895.

The duty imposed upon imported sugar by the Wilson tariff was adopted for the purpose of providing revenue, and not to protect the sugar industry of the United States. For purposes of comparison it may be noted that on the 1894 selling price of Cuban raw sugar it amounted to 1·30 cents a lb. In 1897 it was succeeded by the Dingley law which raised the duty to 1·685 cents, avowedly to encourage the production of sugar in the United States. It is true that the average wholesale selling price of refined sugar increased from 4·50 cents a lb. in 1897 to 4·96 cents in 1898. The obvious explanation of this change, however, lies in the fact that 1898 was the year of the Spanish-American war, which cut down the production and shipment of Cuban sugar to the lowest figure for years. The ratio of demand and supply was here, as always, a more effective price factor than the tariff.

The next important change in the tariff came in 1903 with the adoption of the Cuban reciprocity act, which lowered the duty on Cuban raw sugar from 1·685 cents per lb. to 1·348 cents. Being a reduction, this should have been followed by a decline in the price according to free trade theory, but instead we find that the average wholesale price of refined sugar in 1904 was 4·77 cents a lb., as against an average of 4·64 cents in 1903.

The Underwood tariff law enacted in 1913 made a further drastic decrease in the import duty. It not only reduced the rate on Cuban raw sugar to one cent a lb. from March 1st, 1914, but also provided that after May 1st, 1916, sugar was to be admitted absolutely free. As was made clear at the time, the purpose of postponing the date for the free entry of imported sugar was to give the sugar producers of the United States two years to dispose of their properties and retire from the industry.

Under these conditions, if ever, the reduction in duty should have been passed directly on to the consumer. During March and April there was a temporary decline in the price, which amounted at its height to 0·43 cent a lb. These months mark the apex of the yearly sugar campaign in Cuba, and under normal conditions before the world-war the prices of both raw and refined sugars were usually at their lowest point in these months. If the tariff rather than conditions of supply had been responsible for the reduction in 1914 it should have continued in effect, especially as that year was marked by the largest world-crop on record, but by the end of nine weeks the price was back to the same level that it had occupied before the change in the import duty, and thereafter it continued to rise until the outbreak of war in Europe appeared as a factor in the situation and sent it up to a much higher point than it had reached for years.

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[1] Reproduced from *Facts about Sugar* (New York).

The advance in the duty on Cuban raw sugar made by the emergency tariff of 1921 is so recent that most of our readers are doubtless familiar with its lack of effect on the price. At the time when it became operative, May 28th, 1921, the sale of Cuban sugar was controlled by a single official agency, which promptly attempted to add the enhanced tariff rate to its selling price, the very thing that always happens under such circumstances according to the free trade theorist. In this instance, however, the market refused to advance and the only effect of the action taken by the Cuban selling agency was to exclude its sugar from the market until the asking price was reduced. The market had been declining before the change was made in the import duty and it continued to decline until the end of the year. Leading producers of Cuban sugar testified that the increase of six-tenths of a cent a lb. imposed by the emergency tariff law was paid by the producers in Cuba, and the Cuban Commercial Mission, an official body, estimated that it cost the Cuban producers $32,000,000 on their season's crop.

Exhaustibility of Cane Molasses considered in Connexion with its Composition.[1]

By H. KALSHOVEN.

As we have already had occasion to remark,[2] the fact that the purity of grain-free molasses having the same dry substance may differ by as much as 10° forms an indication that there is a connexion between the exhaustibility of this product and its composition.

Factors influencing Exhaustibility.

Although for a long time efforts have been made to formulate definite laws, which would govern this connexion, yet a careful consideration of the published literature shows that in regard to molasses exhaustibility only a few facts may be regarded as established, namely the following (Java molasses being here considered):

(1) In pure mixtures of sucrose, invert sugar and water, the solubility of sucrose decreases with increasing invert sugar content.[3]

(2) Depending upon their nature and concentration, salts exert either a positive or a negative influence on the solubility of sucrose.[4]

(3) The higher the dry substance content of a grain-free molasses, the lower is its purity.[5]

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[1] Specially translated from the *Archief*, 1921, 29, No, 48, 1702-1708. [2] *Archief*, 1919, 1973. [3] *Idem.*, 1919, 591. [4] *Idem.*, 1920, 1701. [5] *Idem.*, 1919, 1970,

In accordance with the above, it is to be expected that with our impure sucrose-invert sugar-water mixtures (in other words, our molasses), a high content in invert sugar should go with a low sucrose content, that is, a low purity. An indication in this direction is the fact that the purity of beet molasses (which contains very little invert sugar) is always higher than with our cane molasses, although the relatively greater contents in salts present in the beet product must also have an influence.

TABLE I.

	Refractometric	PER 100 OF DRY SUBSTANCE.				PER 100 OF WATER		
No.	dry substance.	Sucrose.	Invert-sugar.	Sulphated ash.	Gum.	Sucrose.	Invert-sugar.	Glucose ash quotient.
I.	II.	III.	IV.	V.	VII.	VIII.	IX.	VI.
1	83·6	36·85	30·65	13·6	0·84	187.8	156·1	2.25
2	84 75	31·5	39·45	12·7	0·35	175·1	219·1	3·11
3	86·05	27 85	38·8	13·55	0·87	172·0	239·3	2·86
4	86·3	32·8	33·3	11·05	1·20	206·6	209·8	3·01
5	83·3	38·05	34·2	14·55	0·52	189 8	170·6	2·35
6	85·35	33·8	28·55	14·85	2·06	196 6	166·3	1·92
8	82·35	39·4	34·35	11·05	0·43	183·9	160·2	3·11
9	82·45	40·95	32·8	10·35	0·91	192·3	154·1	3·17
10	85·93	33·4	33·0	16·45	1·94	204·3	201·9	2·01
11	86·35	31·15	36·75	13·2	1·67	197·1	232·5	2·78
13	85·7	31·0	41·6	12 ·4	1·17	186·0	249·2	3·35
14	85·5	34·55	30·1	16·35	1·56	190·6	166·1	1·84
15	84·05	35·45	36·1	11·85	1·16	186·8	190·1	3·05
16	85·2	30·6	40·45	11·4	1·32	176·0	232·9	3·55
17	81·25	40·55	24·05	14·6	1·80	175·7	104·3	1·65
18	82·6	36·1	34·2	14·35	1·23	171·3	162 4	2·38
19	85·15	30·15	34·0	15·7	1.62	173·1	194 9	2·17
20	85·5	33·65	25·4	14·6	1·76	198·9	149·9	1·74
21	82·05	44·1	26·2	13·15	1·57	201·6	119·8	1·99
22	85·4	32·0	37·75	12·1	1·53	187·5	221·0	3·12
23	85·7	32·45	34·55	15·8	1·29	194·4	206·9	2·19
24	86·1	31·45	32·05	13·65	1·05	195·0	198 6	2·35
25	85·0	35·25	31 8	13·75	1·36	199·7	180·1	2·31
26	81·9	37·25	33·6	12·75	0·54	168·3	151·9	2·64
27	83·55	28·7	42·05	13·4	1·01	145·8	213·5	3·14
28	84·75	31·75	34·3	12·9	1·63	176·4	190·6	2·66
29	81·4	39·75	30·4	14·65	1·29	173·9	133·1	2.08
30	85·7	29·2	33·7	10·65	1·06	174·6	261·4	4·10
31	84·9	34·0	34·4	15·25	0·97	191·1	193·5	2·26
32	84·45	28·3	40·65	13·05	1·14	153·7	220·8	3·11
33	84·0	33·85	34·2	16·0	0·87	177·5	179·6	2·14
34	38·45	36·75	30·35	13·3	1·06	185·7	153·2	2·28
35	84·4	33·25	33·6	13·3	0·72	179·6	181 5	2·45
36	84·2	32·3	34·25	14·6	1·16	172·3	182·6	2·35
37	83·5	41·6	29·6	12·85	1·18	210 6	149·8	2·30
38	83·35	37·1	31·5	11·6	1·44	186 0	157·8	2·72
39	83·55	31·45	36·9	12·75	1·23	160·0	187·7	2·89
40	84·1	33·8	35·45	12·85	1·05	179·2	187·8	2·76

That one has never been able to reach certainty regarding these matters must be ascribed principally to the fact that only seldom has "true molasses" been examined; and by a true molasses we understand one which is in equilibrium at the temperature of examination, one which contains no crystallized sucrose, and thus is grain-free.

INFLUENCE OF FINE GRAIN.

Considered from this point of view, most cane molasses at room temperature are not true molasses, seeing that they almost always contain microscopic crystals. Even at the temperature at which they are centrifuged, they are seldom in equilibrium, the time of cooling being generally insufficient to enable them to attain complete crystallization at that temperature. They may then certainly be grain-free; but in that case they are super-saturated, and after having stood a sufficient time this super-saturation may be slowly decreased by after-crystallization. All molasses which have been examined have had purities which depend on the following factors, in addition to their composition:—

The duration of cooling of the massecuite yielding the molasses; the temperature at which it is centrifuged; and the extent to which the centrifugal gauze lets through fine grain.

The influence of these factors on the purity can become so great that those which may be exerted by the chemical composition may be wholly overcome. In this way, the results obtained by VAN DER LINDEN[1] in his molasses investigations were vitiated, to which fact he had already drawn attention in an addendum to his article.[2]

However, since now it is possible to determine the purity of the grain-free molasses present in the grain-containing product,[3] such a vitiation is no longer to be feared, and the influence of the three factors just named are therefore eliminated entirely, at least when the molasses has stood so long that all super-saturation has disappeared, and a state of equilibrium for the temperature of examination has been reached.

COMPOSITION AND EXHAUSTIBILITY.

In order to obtain a nearer insight into the influence which the composition of a molasses may have upon its exhaustibility, analyses in respect of content in sucrose, reducing sugars, ash and gum were made in the case of a large number of samples of this product (which one would reasonably expect had attained their equilibrium at room temperature, and which on another occasion had been examined for their grain content). The results are found in Tables I and II, in which the third column (sucrose per 100 of dry substance) naturally indicates the purity.

Regarding these figures, the following remarks may be made: (1) No appreciable influence of the gum content on the purity can be detected, though this is not to be wondered at, seeing the relatively small amounts of this constituent present in the molasses. Gums and similar substances certainly exert an influence on the time necessary for a molasses to reach equilibrium, owing to the increase of viscosity they cause. In such a way, these gums may increase the purity of molasses obtained in practice, though their influence on the purity of molasses which have assumed their equilibrium is in appreciable.

(2) In regard to the influence of the reducing sugars, the following may be remarked, the effect of the dry substance being at the same time borne in mind.

DEDUCTIONS OBTAINABLE FROM GRAPHS.

If molasses be regarded as an impure mixture of sucrose reducing sugars, and water, then this 3-component system may be represented by two projections in the following manner. As components we select the apparent water content, the sucrose content per 100 of dry substance of the grain-free molasses (i.e., the purity), and the content in reducing sugars per 100 of dry substance, then the following two figures may be projected:[1] Fig. 1, the purity in comparison with the dry substance content; Fig. 2, the purity in comparison with the content in reducing sugars; whilst the third possible combination, that is, the connexion between the apparent water content and the content in reducing sugars can be deducted from the first and second.

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[1] *I.S.J.*, 1920, 34. [2] *Archief*, 1919, 1559. [3] *I.S.J.*, 1920, 38; 1921, 327, 644.

It appears from Fig. I that with the same dry substance content the purity of two molasses may differ by as much as 15° (for example, Nos. 27 and 37 in the tables). It also may be seen from the form of the curve that a high dry substance content is accompanied by a low purity.

This form of curve occurs also in Fig. II, from which in an analogous way it is to be concluded that a high invert sugar content is accompanied under otherwise similar conditions by a low purity. That here again another influence is at work appears from the fact that the figure is a curve and not a straight line. If we had to do with a system consisting only of a saturated solution of sucrose with varying invert sugar content, then we should have expected to have obtained a straight line.[2]

TABLE II.

		Per 100 of Dry Substance.	
No.	Refractometric Dry Substance.	Sucrose.	Invert Sugar.
I	83·3	32·9	37·85
II	84·7	32·95	37·95
III	84·9	29·9	34·6
IV	81·25	38·75	30·3
V	83·75	41·9	27·85
VI	82·8	32·0	37·6
VII	82·75	36·15	32·4
VIII	85·35	28·45	38 55
IX	86·9	26·05	36·4
X	84·5	32·9	30·55
XI	85·25	32·8	30·6
XII	85·7	30·3	33·45
XIII	83·05	41·4	30 7
XIV	83·4	34·05	33·8
XV	83·1	32·5	39·95
XVI*a*	81·95	40·55	32·8
b	35·7	32·75	34·65
c	83·15	40·55	29·75
d	83·45	10·75	28·2
XVII	81·25	38·1	33·05

That this is not so must be ascribed to the influence of the different non-sugars, principally the salts, which depending upon their nature and concentration either increase or again diminish the solubility of the sucrose. A further discussion of this point, however, is not possible, since at present we know very little of their influence (especially of the organic salts) on the solubility of sucrose. For this reason nothing can be said regarding the value of the glucose-ash quotient as a criterion for the exhaustibility of molasses.

CONCLUSIONS DRAWN.

Finally, the following conclusions may be drawn from this examination: (1) A high dry substance content causes a low purity under otherwise like conditions. (2) A high content in reducing sugars gives *ceteris paribus* a low purity. (3) The percentage of gums usually occurring in molasses exerts no appreciable influence on the purity of the molasses. (4) The non-sugars present (especially the salts) may either increase or diminish the purity of the molasses.

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[1] In the original article these two graphs indicated as Figs. I and II are given, but are not reproduced here.—ED., *I.S.J.*

[2] *Archief*, 1919, 596, Fig. 2.

Correcting for Concentration in the Polarimetric Analysis of Sugar Solutions.

By C. L. HINTON, F.I.C.,

Chemist in Charge of the Analytical Department, British Association of Research for the Cocoa, Chocolate, Sugar Confectionery and Jam Trades, London.

Arising out of a criticism made by the author[1] of the methods adopted by the Bureau of Standards for correcting the Clerget divisor for concentration effects of invert sugar, Dr. R. F. JACKSON and Mrs. C. G. SILSBEE[2] have raised the question as to how the rotation of invert sugar would be affected and the concentration allowed for in the presence of a miscellaneous mixture of other sugars and non-sugars. The Bureau of Standards methods, in the absence of complete knowledge as to the mutual effects of sugars and other substances on their optical behaviour in solution, leave the matter in abeyance, simply correcting the Clerget divisor for the amount of invert sugar formed in the analysis by inversion of the sucrose initially present. The recommendation is added that direct and invert polarizations should be made at the same concentration of total substance. In the writer's opinion, however, sufficient is now known of the behaviour of mixed sugars in solution to allow of a more satisfactory method of correcting the divisor.

In most commercial sugar products the only constituent whose optical rotatory effect is appreciably affected by change of concentration is levulose, in the form of invert sugar. The rotation of the invert sugar in a mixed solution cannot be considered as independent of the presence of the other substances. Dr. JACKSON and Mrs. SILSBEE have shown what a considerable effect dissolved salts may have.[3] W. C. Vosburgh's figures for sugar mixtures show[4] that the optical effect of each sugar should be corrected for concentration as if that sugar were present in amount approximately equal to the total sugars in solution. His figures for sucrose-invert sugar mixtures, as Dr. JACKSON and Mrs. SILSBEE emphasize, deviate from this law, the concentration effect being as though a somewhat larger amount of total substance were present. The deviation of experimental results from the requirements of the above rule is however considerably less than from results calculated by considering each sugar separately at its own concentration, Hence it would appear that the rule enunciated by VOSBURGH represents a useful advance on the old assumption that each sugar was independent of the presence of the others. Moreover, as pointed out by Dr. C. A. BROWNE,[5] the rule is eminently reasonable since it reduces the whole question of the mutual effect of several constituents to a basis of water concentration.

Dr. JACKSON and Mrs. SILSBEE,[2] in their "Note on the Evaluation of the Clerget Divisor in the Analysis of Sugar Mixtures" insist that "the fundamental principle of the Clerget analysis is that the *change* of polarization between direct and invert polarizations is a function of the sucrose," and that they "disregard both the direct and invert polarizations individually." Later, in the same paper, however, it is stated that for sucrose invert sugar mixtures the "total change of polarization is the resultant of two factors: the change of polarization of the sucrose and the small change in specific rotation of the invert sugar" (i.e., due to the deviation from Vosburgh's rule mentioned above). If the concentrations of invert sugar and sucrose in an uninverted solution be m and n respectively, the total final concentration of the inverted solution will be $m + n$ (disregarding the slight increase due to inversion). The first factor, the change of polarization of the sucrose, will be higher than if no invert sugar had been originally present, by the difference between the rotations of invert sugar at concentrations n and $m + n$. The rotation of the original invert sugar, however, as Dr. JACKSON and Mrs. SILSBEE point out, will be reduced slightly in the invert polarization owing to the replacement of sucrose by invert sugar; this reduction is the second factor of the total change. Dr. JACKSON and Mrs. SILSBEE claim that their results show that these two factors balance one another, and that therefore they can both be ignored.

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[1] *I.S.J.*, 1921, 689. [2] *I.S.J.*, 1922, 313.

[3] *Bur. of Standards, Sci. Paper No. 375 ; I.S.J.*, 1920, 509, 570, 638.

[4] *J. Amer. Chem. Soc.*, 1921, 43, 219 ; *I.S.J.*, 1921, 348. [5] *I.S.J.*, 1921, 516.

It is of course possible that for certain solutions this might obtain; Dr. JACKSON and Mrs. SILSBEE state that it does so for all mixtures of sucrose and invert sugar examined by them, but cannot decide whether or not this is accidental. It is very unlikely that it applies in cases where other substances than sucrose and invert sugar are present in appreciable amount and complicate the relations; e.g., mixtures containing starch, glucose, maltose, etc.

It would therefore seem on the whole preferable to make use of Vosburgh's rule, which is at least fairly well obeyed by mixtures so far examined, which is in conformity with the additive relations of carbohydrates in solution as regards other physical properties, and which depends on the simple principle of water concentration, rather than to apply a perhaps fortunate compensation effect for sucrose-invert sugar mixtures to the general range of products in which sucrose is determined by double polarization.

Recent Work in Cane Agriculture.

REPORT OF THE COMMITTEE ON CULTIVATION, FERTILIZATION AND IRRIGATION ON IRRIGATED PLANTATIONS. *Hawaiian Sugar Planters' Association, for the year ending September, 1921. Honolulu, 1921.*

The Committee confines itself to the collection of methods, adopted by the managers of various estates, to carry on the work in the most economical manner possible in view of the shortage of labour. The answers sent in, in reply to the Chairman's circular, some of which are detailed below, are arranged under the three headings mentioned above.

(1) *Cultivation.*—Using a 60 h.p. Best tractor, drawing three ploughs for furrowing: these were found to cover 12 acres a day, thus equalling the work of four 8-horse teams.

Cutting down the fresh planting by two thirds, raising some short ratoons and only cutting back fields that would absolutely certainly tassel. In order to handle the increased ratoons, half-a-dozen Horne double-disc ploughs were requisitioned.

Using short-toothed Horner type implements for light cultivation: for plant canes the banjo type with short teeth and a wire stretched between them: for hilled canes, a one-sided Horner (as illustrated in the Report). Hilling plant canes and thus saving a couple of weedings by hiding or smothering the weeds.

Giving up off-barring the ratoons.

Using a Marker grader or V road drag for making level ditches or clearing out and remodelling any field ditches. By using this behind a double mould-board in the ditches, all hand work on the ditches is eliminated.

Planting whole cane instead of cutting the canes into sets: this saved a certain amount of labour and, incidentally, prevented the loss of eyes where the sets were not carefully cut.

(2) *Fertilization.*—Saving labour by applying the mixed fertilizer in one dose instead of several.

Applying the manure by dissolving it in the irrigation water.

Using fertilizer spreaders which, although saving little in the ultimate cost to the estate, diminish man-power. Filipinos also can be used for this work, whereas they are unsuited for the hand distribution.

(3) *Irrigation.*—Irrigating every alternate row in place of every row. This not only saved water but the weeding charges were reduced.

Employment of special assistants for studying irrigation problems. The most interesting case given is the trial of a "modified orchard system," a full description being appended by the originator.

A considerable number of tractors and implements are referred to in various parts of this Report, for a full understanding of which, however, considerable local knowledge is required.

REPORT OF THE CULTIVATION AND FERTILIZATION ON UNIRRIGATED PLANTATIONS. *Hawaiian Sugar Planters' Association, for the year ending September 30th, 1921. Honolulu, 1921.*

This Report is presented on somewhat different lines to the preceding and the information is not collected under separate headings, but the letters received from the various estates are printed in full. Besides this, there is printed a circular letter from the Chairman, which emphasizes certain aspects of the enquiry, chief among which is the necessity of carefully scrutinizing hide-bound practices which have come to be regarded an inevitable and are thus continued year after year without question. He also suggests that the whole personnel of each plantation should make it its business to study the means of reducing the cost of operations in the field. He refers to the labour stringency in Queensland and the action of the Colonial Sugar Refining Company in sending its Inspecting Engineer to different sugar-producing countries for the express purpose of picking up ideas on labour-saving devices, and also draws attention to Shamel's work on seed selection, the use of the paper mulch for checking weeds, the importance of thoroughly stirring the soil and using a subsoiler (not of necessity every year), and the relative abundance of phosphatic compounds in the soil as revealed by chemical analyses, suggesting that this element might without disadvantage be left out for one or two crops in certain places.

The various reporting plantations are thus given a lead as to the kind of information desired by the Committee, and we shall select some of the manifold subjects dealt with for a somewhat fuller treatment, as applicable to a wider range of conditions than those on the local irrigated plantations. The following are some of the changes which have been effected successfully thus far.

Off-barring ratoons.—In one plantation it has been noted that the heaviest yields have been obtained where this practice was omitted. The following method was substituted, for which it is claimed that labour is saved and as thorough cultivation given as in off-barring. "After the first hoeing and the first application of fertilizer, we run a small one-mule 8 in. plough alongside to cover the manure, throwing the soil toward the hill. When that particular field is finished we turn round and with the same plough throw from each side to the centre of the row, the plough being held at the edge of its previous cut while covering the fertilizer. By this operation we completely cover all the grass and trash that has been hoed out into the centre of the row. We figure it out that it saves us one turn of the Planet Jr. hoe and three turns of the Horner cultivators and also tends to lighten the hoeing . . ." This practice of off-barring ratoons is useful in cutting away old root growth and preparing a bed of loose soil for the new rootlets of the succeeding crop; it also covers the grass and cane débris from harvesting, and keeps the stools in line and prevents them from broadening too much. But in drier tracts it is a question whether a greater part of the furrow is not liable to dry out by the sun and wind, one planter being of opinion that equally good results can be obtained by subsoiling, without the attendant risk of drying out the young roots.

Stripping the cane.—Owing to lack of labour this has been largely abandoned, which in one case mentioned necessitated the burning of a large area before harvesting the canes. It was claimed that this proved quite satisfactory, although of course such burnt cane could not be used for planting material because of the destruction of the buds. Closely connected with this is the question of the necessity of using tops for plant cane.

The use of tops for planting.—At present, it is pointed out by one correspondent, the seed cane is obtained during harvesting, and is therefore a subsidiary operation not receiving the full amount of attention that it deserves. It is claimed that a better planting material would be obtained if it were a major operation when full attention could be given to it. This was done by cutting whole young canes for the purpose, and dividing the whole stems by clean cuts at right angles to the stem. The preparation of good seed beds also is considered to require more attention, as this would save in subsequent hoeing and annual cultivation.

Hilling up.—This practice is called in question as well, especially when several ratoons are to follow. The operation is expensive and increases the difficulty of proper cultivation in these latter. The attendant root cutting is considered as even more detrimental than in off-barring, as by that time they extend all across the space between the rows. Not only so, but the good soil is hilled up against the cane, leaving a V-shaped ditch between the rows, the bottom of which is in the subsoil, thus offering a splendid opening for erosion in heavy rains. Added to this it is urged that the area in which to feed is reduced by the fact that a considerable depth of the hill surface is rendered inert by the way in which it is exposed to the elements, while in dry tracts the practice is harmful owing to the encouragement of the superficial placing of the roots.

Reducing the number of doses of manure.—It is considered that, while two doses are essential in the case of plant canes, one will suffice in the case of ratoons, and this has been successfully demonstrated by one planter.

Paper mulch for checking weeds, etc.—The Report concludes with an elaborate statement of the result of four years' experiments at Olaa with a paper made from bagasse and saturated with asphalt in place of hoeing labour. This is too intricate to be dealt with in a short notice, but among other arguments presented is the claim that the efficiency of the hoeing men is increased from 25 to 75 per cent. It is stated that "the Hilo Sugar Co., in co-operation with the Hawaiian Sugar Planters' Association and Olaa Sugar Company, conducted an experiment in paper mulching last year. The general appearance of the mulched plots, and the effect of the mulch in suppressing weeds was so decided, and the results of an experiment harvested in 1918 were so good, that this year they have adopted the mulch as a field practice on approximately 400 acres." This part of the Report deserves a more careful study than we can give it in this place.

WHITE GRUB IN QUEENSLAND. *Monthly Circulars by the Entomologist, E. Jarvis, from August, 1921, to February, 1922. Bureau of Experiment Stations, Queensland.*

Of the three pests referred to in this batch of typed Circulars, the White grub (*Lepidoderma albohirtum*) occupies much the greater amount of space, and it alone will be dealt with in this notice. The Cane Borer or Borer Beetle (*Rhabdocnemis obscurus*) comes second in importance, while the large Moth-borer (*Phragmatiphila* *truncata*) occupies quite a subsidiary position. The following is a digest of the information regarding white grub in these Circulars.

The ideal method of fighting white grub is agreed among entomologists, says Mr. JARVIS, to be the collection and destruction of the adult beetles, before the female can lay its eggs in the soil of the cane fields. This however presupposes an accurate knowledge of its time of emergence, its habits of feeding, its likes and dislikes—in fact its general natural history while above ground. Of secondary importance is the attack on the grub stage which, inhabiting the soil, does the actual damage to the cane plant by eating its roots. The mature insect, however, can only be attacked during an extremely short space of time, whereas the grub, although obviously less vulnerable because of its surroundings, can be dealt with during a much longer period: this also applies to the eggs and pupae which are in the soil as well. The following are the methods of control dealt with.

In the air: the adult stage.

(1) *Collection of beetles.* Oviposition takes place some three weeks after emergence, and it is therefore important to lose no time in commencing the attack. This plan of collection has stood the test in Europe and America and is worldwide. Among the latest figures, the author states that in Mauritius, during the 1919-20 season, 35 million beetles were collected, against as many as 71 million in the previous year. This, it is argued, is an indication that the method is one of effective control, the grubs not being on the increase except in tracts only recently infested. He learns with regret that the Mulgrave planters (Cairns district) have decided to forgo the collection during the next year. In 1914, 22 tons of beetles were collected in the Cairns district: this would mean about eight and a half millions. This number is considered capable of destroying 11 acres of crop or 165,000 tons of cane: the average loss yearly in the Cairns district through white grub is put down as 30,000 tons. It is noted that the emergence of adults in the previous year was the greatest during the last seven seasons, and all the data to hand together with the experience gained elsewhere point to the likelihood of a record flight of beetles during the next season. In collections made at various places the proportion of males to females worked out at 15 to 14 and 13 to 35 respectively.

(2) *Attracting the beetles.* As a result of anatomical study, it has been demonstrated that the sense of smell is highly developed in these insects, and lies in the end plates of the antennæ. These plates, of which there are four in the female and five in the male, are closely packed with minute pits or pores with central rods closely connected with the olfactory nerve. Besides the extra plate they are closer together in the male. It is presumed that they are able to locate their food plants by means of this sense of smell, working as they do largely in the dark. With these facts before him, the author has inaugurated a series of experiments with various aromas for attracting the beetles in order to capture and destroy them. The tests included aromas of such substance as were likely to prove palatable, the odours of their favourite food plants, of decaying vegetable matter, soils and manures, etc. If the results of this experiment are successful, the arrangement of traps would prove an easy matter.

(3) *Destroying the beetles.* It is considered that the range of flight is limited, at the outside, to a distance of one mile, but the effective range is more like half or even a quarter of this. The beetles show a marked preference in their food plants and the following are mentioned in these notes, presumably as more or less new observations:—*Ficus pilosa*, *F. nesophila* and *Eucalyptus tesselaris*. It is recommended to plant these trees at frequent intervals along the headlands or

even among the canes themselves. The first two have been experimented with as to rapid propagation and can be readily raised from cuttings or by root grafts: it has accordingly been arranged to have a very large number of plants available for free distribution and immediate planting where desired. Meanwhile experiments have been conducted both in the laboratory and in the field of spraying the trees with various poisons, chiefly preparations of arsenic. It has been discovered that the beetles are accustomed only to feed for four or five days after emergence and not after that: also that they take the poisoned bait readily enough if they have not previously fed on unpoisoned leaves, so it becomes important to have everything in readiness when emergence is expected.

When destroyed the beetles have their uses, although these have not yet been exploited. Experience gained elsewhere makes it practically certain that if properly prepared they would form a valuable food for poultry. Specimens were killed by throwing into boiling water, then dried and crushed by passing through a chaff cutter or similar machine. This meal is being tested and a large order has been secured at a good price if the result is a success. Similarly, the dead beetles if available in quantity would probably prove a useful manure, owing to the high nitrogen content which they possess; this is also being tested on a commercial scale. These experiments are of obvious importance, because one of the hindrances to the universal employment of the method is the high cost of collecting.

(4) *Deterring the females from laying.*—This subject has not been dealt with since the time of TRYON, 25 years ago, but it has been taken up by Mr. JARVIS afresh, and an experiment has been arranged on an estate with a block of D 1135 about 18 in. high and in good growing condition. The substances selected for this first trial were coal tar, napthalene, chloride of lime, and carbolineum emulsion. Observations have been recorded as to the length of time during which smell persists so as to be likely to act as a deterrent. The choice is naturally limited to substances that will not injure the young cane, can be handled without danger, are easily applied and are inexpensive—preferably of manurial value and capable of application in the dry state.

In the soil: chiefly the grub stage.

(1) *Fumigation with carbon bisulphide.*—This method, which has undoubted possibilities, has not hitherto been taken up to any considerable extent on the estates. The author prefers several reasons for this:—The original cost of the material, the expense of hand injection and the difficulty of engaging suitable hands for the work, a lack of knowledge of how and when to do it, and apparently considerable doubts as to its efficiency and after effects. A machine has been invented and is being tested which if successful would do away with two of the objections, while if it could be employed it would be quite feasible to make the carbon bisulphide locally at half its present cost. Much knowledge has been gained as to the effects of the method and the best mode of application and the author seems to think that it has a great future before it. Tests have been made as to the penetrating power in different classes of soil and to various depths both in the laboratory and elsewhere, and many of the former failures are clearly due to insufficient preliminary knowledge on these subjects. Also its effects on the various stages of white grub found in the soil have been exhaustively studied and it has been found on trial that the carbon bisulphide can readily make itself felt through the egg covering and the puddled interior of the "form" in which the pupa lies inert while undergoing its changes. It is best applied to well drained volcanic soil or clay loams, thoroughly moist but still porous, a condition which

these soils assume during light showers or two days after heavy rains. Paying attention to such matters has resulted in very gratifying success. It is advisable to commence operations as soon after emergence as possible, when the canes have not grown sufficiently to impede the work, so that its action may at once be felt on the eggs and young grubs. It has been shown that if injected to a depth of 8 in., even in fairly compact soil, it is effective to an average depth of 11 in.

(2) *Arsenical poisoning of the grubs* does not appear to have been the subject of any more experiments during this period, presumably owing to its having been thoroughly studied in a previous year. But a note of warning is issued in one place that there appears to be a marked disappearance of the ibis and other natural enemies of the grub, with the suggestion that this may possibly be due to the poisoning of the latter with arsenic: any large number of grubs taken into the system of these birds would, if laden with arsenic, inevitably be a danger, and the matter deserves investigation.

(3) *Diverting the attention of the grubs from the cane roots.*—White grub is known to be a humus feeder, and if this substance is present in sufficient quantity the cane roots would probably be left alone. An ingenious experiment is described which has been undertaken by an interested planter. A plot of cane has been planted in which each set is placed directly over a quantity of cane trash, while another field of 60 acres has been sown with Mauritius beans which in due course are to be turned in as a green manuring crop, These two methods would, it is surmised, supply the requisite amount of humus, and the results are being awaited by the author with interest.

(4) *The introduction and multiplication of parasites.*—A great deal of work is being done on this subject, especially with the "digger wasp" (*Campsomeris tasmaniensis*). To extend this line Mr. Jarvis has consulted a number of entomologists in various countries regarding possible new species of these parasites on white grubs, with details as to habits, hosts, etc. Meantime various improvements have been made in the method of rearing them in the laboratory which will render it a much easier matter to translate them, if found, from their respective countries to Queensland. A new digger wasp (*Scolia formosa*) has been found in the country, though exceedingly rare. It is thought that this rarity may be due to its being controlled by a hyper-parasite (*Macrosiagon pictspennis*) which is also parasitic on campsomeris.

(5) *The spread of disease among the grubs.*—Interesting observations have been recorded as to the way in which the muscardine fungus attacks the white grub. A number of the latter, paralysed by Scolia wasps, were collected and laid in shallow earthen vessels in the laboratory: on a slight rise in temperature (2° in the average maximum and 8·7° in the average minimum) as many as 22 were attacked by the muscardine fungus, the spores of which had been apparently brought in from the soil. Observations such as this may throw light on past failures and gradually pave the way to more effective use being made of this method of control. Bacteriologists at present working in different countries on cockchafer diseases have also been communicated with and it is hoped that this line may also develop as the result of work being done on them.

C. A. B.

The Hawaiian Chemists' Association and the Hawaiian Engineering Association have been formed into a new society to be known as the Hawaiian Sugar Technologists' Association, and the following gentlemen have been elected officers: Ernest Kopke, President; Irwin Spaulding, Treasurer; and S. S. Peck, Secretary. Chemists; engineers (mill, civil, irrigation and electrical); and agriculturists are all included in this body, the present membership of which is about 325.

Examination Papers set by the Java Syndicaat, 1922.

It seems of interest to reproduce some of the questions set at the 1922 examination conducted by the Algemeen Syndicaat van Suikerfabrikanten in Ned.-Indië for the certificate of sugar chemist.[1] There were also papers on Theoretical Chemistry and First Aid, but only those relating to Sugar Manufacture, Chemical Control, Machinery and Apparatus are here translated.

SUGAR MANUFACTURE.

1. State the amounts of lime added in the different methods of juice clarification, and say how this amount is established. Which disadvantages are attached to the addition of the wrong amount of lime? At which stages, and under which conditions (of temperature and reaction) is sulphurous acid used in the white sugar factory? To which limits in the addition of sulphurous acid does one go at the different stages, and how are these limits determined? 2. How are the different products and intermediate products sampled in a sugar factory? 3. Describe the operation of the sulphur oven; state the irregularities that may arise in its use, and the means to be adopted in overcoming them. 4. Owing to which causes may the quality of the white sugar be unfavourably affected after evaporation in a factory making superior first sugar and molasses?

CHEMICAL CONTROL.

The following data are taken from a factory report, and have reference to a 15-day period: Cane entered, 346,666 piculs; cane remaining from previous report, 2341 piculs; maceration water, 38,412 piculs; remaining to date, 3447 piculs; sweet-water, 10,005 piculs of the following analysis: Brix, 8·12; sucrose, 6·58; and polarization, 6·35.

	PICULS.	BRIX PICULS.	SUCROSE PICULS.	PURITY Sucrose/Brix.	POL'N. PER CENT.
Raw juice	311,044		40,031	82·0	12·78
Thin-juice				83·2	4·66
Press-cake	8,635				
Superior first S.	26,855	26,855	26,801		
Superior second S.	4,954	4,880	4,836		
Molasses	13,659	12,648	4,589	36·3	
Former stock-taking		3,300	2,060		
Last stock-taking		4,266	3,956		
Re-melt sugar (this crop)	390	390	389		
Re-melt sugar (previous crop)	560	556	554		
Bagasse					4·15

(N.B.—The sugar is re-melted after the place at which samples of the thin-juice are taken, and thus exerts no effect on the analysis of this thin-juice).

Questions asked are: (1) From the above data make sucrose and Brix balances for the expired period. (2) Calculate the "sugar winning quotient." (3) Calculate the rendement from the cane in standard muscovado. (4) Calculate the crystal recovered per 100 calculated in the thin-juice, and the non-sugar accounted for per 100 of non-sugar in the thin-juice. (5) How many more piculs of standard muscovado should be obtained if the molasses were exhausted to 35·0° (calculating only on the 13,659 piculs of molasses produced).

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[1] *Archief*, 1922, 30, No. 17, 285-289.

Machinery and Apparatus.

1. Give a simple sketch of a sugar dryer with accessory apparatus, and explain its operation. 2. A quadruple evaporator has bodies of 250, 150, 150, 150 sq. m., and evaporates 20 kg. of water per sq. m. per hour. From the first body juice vapour is withdrawn for use in a raw juice heater, through which 30,000 litres of juice pass per hour. (*a*) What is the highest temperature to which the juice can be heated (using only juice vapour) when it enters at 30°C., 1 litre of juice requiring 0·9 cal. per 1°C. increase, the temperature of the juice vapour of the first body being 100°C., and the temperature of the condensed water from the juice heated also 100°C., heat losses being disregarded ? (*b*) What must the heating surface of the juice heater be when the coefficient of transmissson is 9 ? (*c*) The length of the juice heater tubes is 3 m., and the internal diam. 30 mm. ; and the rapidity not greater than 1 m. per sec. How many tubes should there be in each bundle, and how many bundles of tubes, the tube plates not being reckoned as heating surface ? 3. In which unit does one express the power of a steam engine ; and how is the power estimated in practice ? 4. What data are necessary for the calculation of the capacity of a pump ? Give an example, explaining the significance of the letters used. 5. The engine for an crystallizer installation makes 100 revs. per min., and has a pulley with a centre line of 1200 mm. The driving shaft of the crystallizer to which the worm is fixed makes 150 revs., and the stirring shaft 2·5 per min. Calculate the diameter of the pulley on the worm shaft, and the number of cogs of the worm wheel of the stirring shaft.

Publications Received.

Power Alcohol : Its Production and Utilization. By S. W. Monier-Williams, O.B.E., M.A. Pp., 323, with 48 figures. (Henry Froude and Hodder & Stoughton, London.) 1922. Price, 21s. net.

Dr. Monier-Williams' book will be welcomed by the large number of engineers, chemists, and others who both here and in various countries are taking considerable interest in the development of power alcohol. Although at the moment there would seem to be a surplus of petrol, there are many indications that with the revival of industrial prosperity the demand will again tend to outstrip the supply. A survey of the U.S. oil-fields is said to have shown that their total exhaustion at a normal rate of consumption is a matter of 25 years only; so that, unless the results obtained from existing oil-fields, and new ones now being explored, exceed all expectations, it means that any possible source of liquid fuel will have to be extended to the utmost. Contemporary vegetation appears to constitute the only alternative to bitumenous mineral deposits as a source of motor spirit (if one excludes the possibility of a suitable material being produced by inorganic agency from the hydrogen of water and the carbon of carbon dioxide or carbonates) and it would seem that alcohol must eventually supply a large proportion of the world's requirements in liquid fuel. Therefore, a work on this subject summarizing in a readily accessible form the large amount of literature which has been published during recent years (and giving copious references to the original sources) is opportune. One of the best chapters deals with the economics of alcohol production from various crops, where the factors governing the price at which the material required to produce 1 gall. of spirit can be delivered at the distillery are discussed. It is there shown that the crop giving the highest yield of alcohol per acre is not necessarily the cheapest source of alcohol, the controlling factor being the cost of producing and delivering to the factory a unit of fermentable carbohydrates. Cellulose is available in immense quantity in different parts of the world; and a biological process for the direct conversion of this substance to sugars on a commercial scale would be a discovery of immense importance, making it possible to utilize the luxuriant vegetation of the tropics and the by-products from the wood-pulp and timber industries. Then Dr. MONIER-WILLIAMS contributes two conspicuously valuable chapters, the first giving an illustrated account of the technique of alcohol production, that is, processes of fermentation and rectification; and the second discussing the properties of alcohol from the motor fuel standpoint. In other chapters, engine tests; denaturing and exise; and synthetic production are dealt with, and in these sections much useful information is contained. Dr. MONIER-WILLIAMS' task of bringing together a clear and well-balanced account of the immense amount of work which has now been published on the engineering, chemical, biological, and economical aspects of the subject has been no easy one. He has accomplished it with marked success, and has produced a book which should be in the hands of all who are in any way interested in the important question of power alcohol.

Soil Conditions and Plant Growth. By Sir Edward J. Russell, D.Sc., F.R.S., Director of the Rothamsted Experimental Station, Harpenden. Fourth edition; With illustrations; 406 pages. (Longmans, Green & Co., London and New York). 1922. Price, 16s. net.

This is the fourth edition of Sir Edward Russell's well-known monograph. At the time of the appearance of the previous editions[1], we have drawn attention to its particularly valuable nature, and have emphasized the opinion that it is the work *par excellence* for all those who wish to make a study of the conditions of the soil and how they effect the growth of the plant. This fourth edition, though on the same general lines as the previous ones, has been throughly brought up-to-date, and as the subject is one of such rapid delevopment the revision of each chapter has been necessary. However, it is now announced by the editors that the book will henceforth be included in "Rothamstead Monographs of Agricultural Science", and that other volumes of the series will be contributed by the staff of the Experimental Station at Harpenden on Soil Physics, Soil Protozoa; Soil Bacteria; Soil Fungi and Algæ, and Chemicals Changes in the Soil, of which subjects Sir Edward in the book before us had discussed only the fundamental principles. This new book, therefore, retains its essential characteristics as a monograph, giving a comprehensive survey of the subject, such as the botanist, the ecologist, and the agriculturist is likly to require. We warmly recommend it as a volume to be studied in order to follow the important developments in our knowledge of the relations between the soil and the growing plant.

Catalysis with Special Reference to Newer Theories of Chemical Action. Reprint from the *Transactions of the Faraday Society*, 1922, 17, Part 3. (The Faraday Society, London.) 1922. Price, 9s. net.

This is the report of a discussion which took place at a special meeting of the Faraday Society recently. The contributors being: Prof. J. Perrin; E. C. C. Baly, F.R.S.; Prof. T. Martin Lowry, F.R.S.; Dr. Irving Langmuir; Prof. Svante Arrhenius; Prof. F. A. Lindemann; and others.

Dictionnaire Anglais-Francais-Allemand. By R. Cornubert. (Dunod, 47 & 49, Quai des Grandt-Augustins, Paris). 1922. Price: 42 francs.

This is a useful technical dictionary of words that are likely to be met with in the English, French, and German languages. It is complete, accurate, and up-to-date, and should prove of much service to those who have occasion to peruse foreign, chemical, and physical literature.

Bulletin No. 5: Bureau of Bio-Technology. (Murphy & Son, Ltd., London, Leeds, and Nottingham.) 1922.

Contents: Guilliermond's book on yeasts; isolation of bacteria from beer deposits; soil sterilization; control of "red spider" disease.

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[1] *I.S J.*, 1913, 483; 1915, 330; 1917, 521.

American Commerce Reports.[1]

CONDITION OF THE ITALIAN SUGAR INDUSTRY.

The coming reestablishment in Italy of free trade in sugar, together with the reduction in tariff that has been announced and the greatly increased area of spring sugar beet plantings, may be accepted as evidence of the ability of this country to provide for its own sugar needs with the beginning of the next campaign. The area devoted to sugar beets this spring, according to estimates made by the Italian Domestic Sugar Association, will not fall short of 80,000 hectares (198,000 acres).

In the past six years Italy has imported sugar to the amount of 356,000 metric tons, or an average of nearly 60,000 tons annually. In 1921 the imports were record breaking, reaching 97,000 tons, in spite of the fact that the 1921-22 crop was 90,000 tons in excess of the average for the preceeding five years. This heavy buying abroad last year was doubtless due to the extremely low rates at which sugar could be imported, as well as to depleted stocks resulting from restricted imports during 1920; but, having made these allowances, there is no doubt but that Italian consumption of sugar is rapidly increasing.

Imports of sugar into Italy during the past four years and in 1914 are given below (in metric tons) by countries of origin:

COUNTRIES.	1921. TONS.	1920. TONS.	1919. TONS.	1918. TONS.	1914. TONS.
France	3,448	1,524	55	144	726
Japan	132	431	1,690	77	—
Dutch East Indies	58,034	1,576	5,047	3,559	2
Brazil	2,221	241	3,339	8,413	—
Cuba	3,901	180	193	475	—
United States	20,480	6,635	59,941	8,610	5
Belgium	6,247	—	—	—	1
Austria-Hungary	23	—	—	—	3,975
Other countries	2,134	789	9,216	15,753	178
Total	96,620	11,376	79,481	37,031	4,887

Increase in sugar consumption is due not only to the tremendous growth in population of the country but also to a rise in the scale of living that has carried with it a broader per capita demand for sugar. Ten years ago both meat and sugar were used sparingly and were regarded as luxuries by the average Italian family of limited means. Wine, cheese, vegetables, fruit, macaroni, and bread were the principal food staples. The annual per capita consumption of sugar, including that for industrial as well as domestic purposes, amounted to no more than 10 lbs. before the war, whereas at present it is about 16 lbs.

There still remains a broad field for further development of sugar consumption. New sugar consuming industries are springing up, such as jam, chocolate, and candy factories. With cheaper sugar more attention is being given to utilizing the natural fruit resources of the country, and an increasing business is being done in fruits preserved in sugar and syrup.

All things considered, it is a question whether production, even under the most favourable conditions, will succeed in exceeding domestic needs to any considerable extent. The sugar year of 1913-14 was quite exceptional both for the area planted to beets and the tremendous outturn of sugar. Not less than 305,000 tons were produced, or about 35,000 tons above the average consumption at the present time. It may be noted, however, that in this year of plenty hardly 30,000 tons were exported. The year 1912-13 was the next best from the standpoint of production, but only about 1,000 tons were exported then. In no other year have exports been as high as 300 tons. This indicates that, with the present large population and increased consumption, there is little probability of Italy entering the export trade in sugar on a broad scale, despite the abundance of labour both on the farm and in the sugar factories.

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[1] Culled from "Commerce Reports," published by the Department of Commerce, Washington. In many cases these are abbreviated here.

The number of sugar factories in Italy is now 38, precisely what it was before the war; of these, 35 were in operation last year. In 1914 only 30 mills were in operation, whereas for the coming season it is expected that all 38 will be working. Wages in beet factories reached their peak early in 1921, and a recession is now noted. Unskilled labour in these factories was paid 3 lire per day before the war; the present wage scale is 18 to 20 lire per day.

In Germany any great expansion in the sugar production is checked by the scarcity of hand labour. In Italy the check is not one of labour but of available land. Although beet growing improves the soil, the qualities of land suitable for its production in Italy are strictly limited. The primary need being bread rather than sugar, grain growing in the fertile plains of northern and eastern Italy tends to drive out beet growing at present prices of sugar and flour. So long as this country has to import some 2,000,000 tons of wheat annually, there is little prospect of the conversion of extensive grain areas to beets. In short, Italy may next season produce enough sugar to cover its own requirements, but there is small likelihood that the country will become an important factor in the export trade in sugar in the next four or five years.

The area planted to sugar beets in Italy, the production of beets and the amount actually worked, and the sugar output from 1913-14 to 1921-22 are shown in the table below:

Campaign.	Sugar Beets. Area. Hectares.	Sugar Beets. Production. Metric Tons.	Sugar Beets. Amount Worked. Metric Tons.	Sugar Output. Metric Tons.
1913-14	82,348	2,749,907	2,716,880	305,564
1914-15	38,887	1,319,140	1,290,243	150,216
1915-16	51,725	1,457,571	1,435,673	150,396
1916-17	44,127	1,313,690	1,247,673	144,870
1917-18	44,698	883,038	838,575	92,624
1918-19	42,318	1,117,743	1,066,600	108,431
1919-20	58,735	1,800,917	1,750,527	167,767
1920-21	51,078	1,267,815	5,232,736	124,392
1921-22	73,000	1,685,000	1,641,458	217,532

[Dept. of Commerce Report, April, 1922.]

Unfavourable Outlook for Foreign Imports into Cuba.

With the approach of the "dead season," the current outlook for business as a whole in Cuba is less encouraging than in April. The demand created during the active grinding season by the money put in circulation in payment for wages and supplies has dropped off, and the Upmann bank failure continues to exercise a depressing influence. During the month of May the Government has been going through a very trying period, in which public opinion has become increasingly insistent on reduction of public expenditures and a readjustment in public administration. The proposed heavy increase in internal taxation has caused anxiety in all branches of industry and the marked increases in the customs tariffs proposed in the two bills before Congress have made the outlook for import trade less bright.

Least encouraging are the prospects in the machinery trade. Inquiries for sugar-mill machinery have improved, but the terms demanded by American manufacturers are so strict that only a small amount of business involving new shipments is being done. In normal years this is the season for active inquiry for machinery, but the heavy local stocks of general machinery overhanging the market are moving very slowly.

The Swedish sugar import monopoly is prolonged by a Royal Order till June 30th, 1923, or until further notice.

Brevities.

It is stated that, owing to the stagnation in the wine market, the Natal Cane By-Products Co., have arranged to distill 10 million galls. of South African wine for conversion into motor fuel.

The Distillers Co., Ltd., have put on the market an alcohol motor fuel, which is selling for about the same price as third grade petrol. It is called "Discol," and is being made at the Hammersmith Distillery, and so satisfactory have the results been to date that arrangements are being made to produce this spirit also in Liverpool and Glasgow.

Publication of the Java *Archief* is now carried on by a Committee consisting of the following gentlemen:—Dr. J. M. Geerts, G. Nyenhuis, and J. M. L. Alberti for Agriculture; Dr. T. van der Linden, A. Schweizer, and H. Schmidt for Chemistry; F. W. Helmers, Q. A. D. Emmen, and E. Mooyaart for Technology; G. H. C. Hart, I. Rinkes and H. Offerhaus for Economics; J. van Harreveld being Secretary to this Editorial Committee.

According to the *Times Trade Supplement*, shipments of sugar to Canada from Jamaica during 1921 included £191,237 worth of yellow crystals, which would seem to indicate that the adoption by the Canadian Government of the No. 16 D.S. under which a preference is given to raw sugar has not had the effect of keeping the better grades of sugar out of the Dominion market.

Sugar, when used for the preparation of syrups for use in the manufacture of "soft drinks" should, it is asserted, be inverted in order to give a product which is sweeter than the original sucrose, the following method being stated to give good results: 100 lbs. of sugar and 50 grms. of tartaric acid are dissolved in 45 lbs. (4¼ gall.) of water, and the mixture boiled gently for 30-35 min.

C. N. Hinshelwood and H. Hartley[1] report the results of experiments showing that the tendency of a supercooled solution to crystallize depends upon the temperature to which it has been previously heated, on the number of times fusions and solidification have taken place, and on the length of time it has been maintained in the fused state, thus confirming the results of previous workers in this field.[2]

Dr. W. L. Owen[3] points out that of the 41 million gallons of cane syrup consumed during 1921 in the U.S., only 17 per cent. was supplied by Louisiana, among the other principal contributing States being Georgia, Alabama, Florida and Texas. In addition about 39 million gall. of sorghum syrup and 82 million gall. of corn syrup were consumed, the total with maple syrup and edible cane molasses amounting 170 million gall.

The Petree process for obviating filter-presses in raw sugar mills continues to find further extension in the sugar industry. In Hawaii, Mr. C. G. Petree has just closed contracts for the process and the machinery required with the Maui Agricultural Co., for their large Paia factory, and with the Hawaiian Commercial & Sugar Co., for their large Puunene factory. This should ensure Hawaii giving the process a thorough trial.

C. E. Coates and A. F. Kidder state[4] that it is possible to grow sugar beets of high sugar content and high purity in Louisiana and to obtain good yields, the best results being obtained by late spring planting. The sucrose content averages 14·0; the purity, about 85; and the yield, 18 tons per acre. It is said that the quality of the beet seed is vital; it must breed true to type. Seed grown in the U.S.A. fulfils this requirement, and would seem to be somewhat better than the best European seed.

We have received from a German engineering firm a well-compiled brochure, which it is issuing to the Press in celebration of its fiftieth anniversary. This firm has equipped a number of the largest sugar factories in Germany, and several in Italy, Poland, Holland, etc.; and it appears also to have made something more than an effort to enter the cane industry, particularly in Java. A graph illustrates the dividends it has been paying during the past few decades. In 1896 the peak was reached at 40 per cent.; in 1900 it was about 36; in 1903 an extraordinary drop to 10 per cent. occurred, which, however, was rapidly recovered, until in 1906 about 34 per cent. was reached, the average between that date and 1915 being about 27 per cent.

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[1] *Philosophical Magazine*, 1922, January.

[2] *I.S.J.*, 1921, 469.

[3] *Facts about Sugar*, 1922, 14, No. 16, 309.

[4] *J. Ind. Eng. Chem.*, 1922, 14, No. 3, 213–214.

Brevities.

Invertase, the enzyme or unorganized ferment that converts sucrose into invert sugar, is now being supplied under the name of "Difco" by an American firm in sterile ampoules or in bulk, being described as "a selective hydrolyst for sucrose to replace hydrochloric acid in the Clerget method." Dr. C. A. Browne[1] has stated that "the invertase method is unquestionably the most ideally perfect of the numerous Clerget modifications"; and the fact that it can now be readily obtained in a highly pure form should induce chemists to use this hydrolyst in their double polarization determinations.

The capacity of the Jamaica sugar factories (says a Colonial Office report) that is those now in existence and those in process of erection, is sufficient to maintain an export of about 60,000 tons of sugar per annum, if a remunerative market can be assured. The recent revival in the prosperity of the banana industry has checked the transfer of banana cultivation to that of sugar cane, and under present conditions the tendency is rather to extend th production of bananas in Jamaica than to plunge too deeply into sugar.

It is pointed out[2] that there are now a number of factories in Cuba turning out a grade of plantation white known as *turbinado*. This sugar may be produced either directly from the well-clarified syrup (the molasses being worked up into raw sugars); or it may be made by washing up raws to a high degree, re-melting, boiling the liquor, and centrifuging and drying the sugar, a fair granulated which is used by many of the higher class of inhabitants in Cuba and also exported to a certain extent being thus obtained.

A new Spanish Customs Law provides increased duties since the end of June last on sugar and sugared goods. There is a Customs duty of 85 pesetas per 100 kg. net on sugar, glucose, liquid caramel and similar products, and consumption duties of 45 pesetas per 100 kg. net on sugar of Spanish manufacture and 22·50 pesetas net on glucose; but authority is given to reduce temporarily the import duty by 15 pesetas if Spanish manufacturers take advantage of the protection thus afforded to raise their prices unduly.

The Cuba Review states that while it is not known what disposition will be made of the numerous sugar mills in Cuba held by banking institutions, it is believed that as soon as practicable, arrangements will be made to turn them back to the original owners, or to sugar interests for operating, as it is generally understood that the banks are not interested in the working of these mills any longer than is required to complete financial arrangements necessary to have them relieved of their operation and control.

A Consular Report states that although enormous sums have been made and lost in the past two years in the sugar trade of Java, yet with the exception of the failure of a large Scandinavian firm and two of the largest British Indian speculators consequent upon the heavy decline in the latter part of 1920, the trade generally has passed through the crisis satisfactorily. A liberal spirit of co-operation on the part of those concerned has averted wholesale disasters and saved this premier industry from ruin.

The *Times Trade Supplement* states that, according to competent authorities, United Kingdom refiners may this year melt 1,000,000 tons of sugar and that the total consumption in this country may be from 1,500,000 tons to 1,600,000 tons. The supplemental half million tons will be obtained principally from Canadian and American refineries. The estimated consumption for the present year is expected to be: For domestic consumption 52 lbs.; for all other purposes (confectionery, brewing, syrups and preserving) 19 lbs.; or a total of 71 lbs. per head.

A Bill has been introduced into the South African Parliament to provide *inter alia* for the prohibition, regulation, or restriction of the importation of sugar, and for the regulation of the maximum prices of different classes of sugar. The Bill provides that the Governor-General may, as regards sugar imported into or produced within the Union, prescribe the maximum prices which may be charged or demanded by any person on a sale of any class or kind of sugar; and may make Regulations for carrying out effectively any powers confirmed on him by the Act. The latter is to be effective for 12 months from July 1st, 1922.

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[1] "Handbook of Sugar Analysis," page 275.

[2] *La. Planter*, **1922**, **68**, No. 14, 213.

Trade Notices.

Fulton Steel Mill Buildings. Bulletin 102. (Fulton Iron Works Company, St. Louis, Missouri, U.S.A.)

Realizing the importance of the proper housing of the cane mill, the Fulton Ironworks Co., have developed steel mill buildings, a description of which is given in this bulletin. These buildings are designed by specalists bearing in mind the importance of requirements of good natural lighting, ventilation, positive protection from the weather, greatest flexibility in arrangement of machinery, and the possibility of expansion in any direction. Substantial in construction, the Fulton Mill House is built to withstand all loads, external forcee and deteriorating effects of tropical climates. Each building may be designed to conform with any given set of requirements, and is manufactured to confirm strictly with the demands of the standard specifications for structural steel for buildings, prepared by the American Society for Testing Materials. This booklet makes interesting reading, and should be in the hands of all contemplating new housing equipment. Special plans will be supplied by the Fulton Ironworks Co., on receipt of particulars of the type of building required

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Sugar Mill Roll and Repair Service. (Farrel Foundry & Machine Co., Ansonia, Conn., U.S.A.)

This pamphlet gives illustrations and particulars of the two plants of the Farrel Foundry & Machine Co., the first of which at Ansonia covers about 13 acres, and the second at Buffalo, N.Y., about three quarters of that space. This company specializes in providing new mill rolls and re-shelling old ones, and has developed an iron mixture combining in a remarkable degree the qualities of durability and openness of grain (producing a constantly rough surface on the roll). They make all kinds of grooving on both crusher and mill rolls, and furnish crusher rolls of all types in common use. They also re-shell rolls of any make, and on receipt of an order with accurate shaft dimentions, they rough cast the new shell in readiness for the arrival of the old roll, thus providing quick and accurate service. Farrel hydraulic caps embody rapid replacing of packing in the hydraulic pressure regulator and in making the replacement it is only necessary to disconnect one joint, slip out the cylinder in the cap, slip in the spare cylinder. and re-connect. This hydraulic cap can be supplied to any existing mill, and full particulars of this and the other specialities of this firm will be sent to any sugar engineer on application.

Rees Roturbo Rotary Jet Condensers. Pamphlet R 197. (Rees Roturbo Manufacturing Co., Ltd., England.)

The Rees Roturbo jet condenser is distinct from all other types of condensing plant, and embodies the latest investigation as applied to this particular field of engineering. The chief aim has been to produce a machine that will condense the steam in the minumum of space with a low expenditure of power and in the simplest manner. A special pressure drum impeller has enabled this to be done in such a way that the foregoing requirements are fulfilled. It retains the advantages and simplicity of the ejector condenser with the economy and certainty of action of the barometric. It is particularly efficient with the higher ranges of vacuum, 26 in. and above ; the floor space occupied is very small ; the initial cost is moderate ; the maintenance cost is slight ; the starting and operating is automatic ; the water consumption is very low ; and it is devoid of all clearances which, owing to re-evaporation and expansion, limit the volumetric efficiency of all types of reciprocating air pumps. Sugar engineeers should secure a copy of this pamphlet, which gives much useful information regarding condenser plant generally.

Barclay Light-Class Locomotives. (Andrew Barclay, Sons & Co., Ltd., Caledonia Works, Kilmarnock, Scotland.)

Barclay light-class locomotives are exceptionally powerful and robust machines, and have been primarily designed to meet the requirements of overseas customers. Being designed with a low centre of gravity, they are remarkably suitable for working on light and poorly ballasted rails. The fireboxes are of the Belpaire type, the crowns being stayed by direct stays of iron, or special mild steel ; the dimensions are particularly generous relative to the tractive effort, and the boilers are first-rate steamers ; the wheelbase is short, and is suitable for negotiating curves of short radius. Engines for wood burning can be arranged with spark arrester in the smokebox. This booklet gives specifications and illustrations of various types of locomotives, and a copy should be in the hands of all concerned with the transport of cane on the plantation.

Review of Current Technical Literature.[1]

SETTLING PROBLEMS. *Willard A. Deane.* *Transactions of the American Electro-Chemical Society, 1921, 660-688.*

This is a study of the theory underlying sedimentation, more particularly in connexion with the application of the Dorr continuous "thickener" in metallurgical work. There are two distinct phases to every settling problem, one dealing with conditions meeting the desired clarity of "overflow" (that is, clarification), and one governing the requirements for proper moisture content in "underflow," that is thickening. Settlement of the finest particles (a proportion of which may actually be in the colloidal state) is the governing feature in clarification. Flocculation is often an effective means for increasing the rate of settling, though it retards the process of thickening, causing a lower final density. Temperature is also one of the most widely used agencies for improving the settling qualities of a mud, and exerts no deleterious effect on thickening, being in fact sometimes of assistance. Each settling problem is governed by specific conditions requiring independent study and analysis, and the most satisfactory solution often involves a study of processes and methods with a view of possible changes in certain conditions, so as to alter the physical character of the suspension and promote improved settling.

CANE AND BEET MOLASSES, THEIR COMPOSITION, AND COMPARATIVE VALUES FOR CATTLE FEEDING PURPOSES. *H. C. S. de Whalley.* *J. Soc. Chem. Ind., 1922, 41, No. 8, 169R.*

Hitherto little molasses has been fed directly to stock in this country; but it has now become customary for farmers to use it mixed with their rough fodders (as chopped straw, inferior hay, etc.). Analyses made by the author show the following results for the cane and beet products:—

	CUBAN CANE.	ENGLISH REFINERY CANE.	GERMAN BEET.	AMERICAN BEET.	ENGLISH REFINERY BEET.
Water	21·12	24·20	23·84	21·00	20·0
Ash	6·65	6·07	9·60	12·17	10·0
Albuminoids	4·68	1·50	9·57	66·83	70·0
Carbohydrates	67·55	68·23	56·99		
	100·00	100·00	100·00	100·00	100·00
Carbohydrates containing:					
Sucrose	35·70	38·00	49·65	50·51	50·0
Invert sugar	18·30	21·50	0·24	0·06	0·5
Non-sugar	13·55	8·73	7·10	—	—
Total sugars	54·00	59·50	49·89	50·57	50·5

Thus beet molasses is characterized by high ash and nitrogen contents, and very low invert sugar; while cane molasses is lower in ash and nitrogen, and approximately half its sugars consist of invert sugar. Cane molasses is much preferable to beet for feeding purposes, the former having an appetizing smell and taste, a low content of alkali salts, and a high content of total carbohydrates (sucrose and invert sugar); whereas beet molasses has an unpleasant smell and taste, a high content of alkali salts, and unusually about 10 per cent. less total carbohydrates. Its nitrogenous substances are mainly amides and some nitrates. However, these remarks do not apply to peat-moss and beet molasses combinations, since during the manufacture of these a good deal of the unpleasant smell is lost, while the alkali salts combine with the humic acids to form insoluble substances which are excreted by the live stock without harmful results.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*

ALCOHOL MOTOR FUEL, ITS COST OF PRODUCTION FROM VARIOUS TROPICAL PLANTS. *H. N. Whitford.*[1] *Journal of Industrial and Engineering Chemistry, 1922, 14, No. 2, 151-152.*

Bamboo.—Areas of wild small bamboo growing in the Philippines to a height of 43 ft. in one season are known to yield enough material to make seven tons of pulp per acre, the cost of cutting and transporting by crude methods being $1·25 per ton. One ton of pulp would give about 40 gallons of alcohol; and the average cost of the raw material per gallon of alcohol would work out (it is said) at only $0 03. After the wild plant has been harvested, its re-planting and bringing to maturity (which would take about five years) would cost about $26 per acre, and when once established and properly managed such plantings could be made to yield crops indefinitely, probably with an increased yield per acre. *Nipa Palm.*—About 750 plants per hectare can be made to produce sap; 43 litres of sap are obtained per plant per season; that is, 32,250 litres of sap per hectare; yielding about 210 gallons of alcohol per acre; and the cost of the raw material may work out at 12 cents per gallon of alcohol. In 1911 a distillery in the Philippine Islands produced 93 per cent. alcohol at a cost of about 20 cents per gallon on a 12-hour basis, equal to about 15 cents on a 24-hours basis. Other crops mentioned are cassava, wild grasses, and maize.

COST OF THE MANUFACTURE OF ALCOHOL-ETHER MOTOR FUEL ("NATILITE"). *Anon.* *Sugar News, 1921, 2, No. 12, 558-594*

Following is the estimated cost of an alcohol ether plant making 1000 gall. per day of 24 hours, no allowance being made for the ground site (it being assumed that the erection would be on the plantation premises), nor for the molasses (this being taken to be almost waste product, the small cost of which is offset by the fertilizing value of the spent wash). *Boiler room.*—One 75 h.p. steam boiler, $1572; oil and water feed pumps, fittings, etc., $2000. *Fermenting room.*—One molasses scale, $400, two 7500 gall. mixing tanks, $388; twelve 6500 fermenting tanks, $2164; three 2000 gall. yeast tanks, $212; three 250 yeast tanks, $58; two pumps, $400. *Still room.*—One modern continuous still producing alcohol of 96-97 per cent. in one operation, $6000; two 1000 gall. charging tanks, $115; one 1000 gall. singlings tank, $57. *Denaturing warehouse.*—Two 2000 gall. metal receiving tanks, $440; one denaturant storage tank, $250; one 500 gall. denaturing tank, $100; one air compressor, $200. *Ether room.*—One modern sulphuric ether generator, $3500; one 1000 gall. supply tank, $57; one ether storage tank, metal, 1000 galls., $144. *Finished motor fuel storage room.*—Two 5000 gall. tanks, $368; one 1500 gall. mixing tank, $58; one pump, $200. *General.*—All piping throughout plant, $2000; miscellaneous expenses, $1815. *Buildings.*—Greatly varying as to type of construction, preparation of site, location, materials, etc, estimated at $12,502; a grand total of $35,000.

In computing the daily cost of operating the plant for the production of 1000 galls. in 24 hours, the following figures are taken—19·34 tons of average cane molasses, nil; 34 lbs. 66°Bé. sulphuric acid, 2·5 c. per lb., $0·85; 14 lbs. caustic soda, 5·4 c. per lb., $0·76; 21 galls. benzene, 50·0 c. per gall., $10·50; 10½ galls. pyridine, $1·86 per gall., $19·53; 40,000 galls. water, diluting, condensing, etc., pumping cost of 10 c. per 1000 galls., $4·00; 6½ bbls. fuel oil, $7·28 per bbl., $47·32. *Labour.*—One fermenting-room man and foreman, day shift; two distillers, night and day shifts; one denaturer, day shift; one ether man, day shift; two firemen, day and night; one labourer, total $25·50. Interest at 8 per cent. on $35,000 over 312 working days, per day $8·97; insurance on one-third plant value, premium $3·00 per 100 per year, per day $0·11; depreciation at 10 per cent. per year, $3500, per day $11·21; office expense, general overhead, etc., per day $10·00; grand total, $138 75. This, therefore, works out at 13·85 cents per gall. on a conservative basis; but if the plant were larger this cost, it is stated, would be 10 to 30 per cent. less.

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[1] Yale School of Forestry, Yale University, New Haven, Connecticut.

Review of Current Technical Literature.

PREPARATION OF CANE TABLE SYRUP. *A. E. Collens and F. H. S. Warneford.* *West Indian Bulletin, XIX, No. 2, 154-160.*

In the manufacture of table syrup from cane juice, it has been recommended[1] that, in order to provide the necessary acidity to effect a sufficient amount of inversion, a definite volume of sour juice about 24 hours old should be mixed with each batch of fresh juice. However, on investigating this point it was found by the authors that the acidity of juices 24 hours old may vary to an extent sufficient to seriously affect the degree of inversion. They have also observed that the initial acidity of the cane juice and the final polarization of the finished syrup are closely related, as the curve obtained on plotting the two series of values (the initial acidities varying from 0·043 to 0·108 c.c. of N/2 acid per c.c. of juice) is practically a straight line, the defecation of the juice being carried out with kieselguhr and the time of evaporation being about two hours. Consideration of these curves indicates that for a syrup concentrated in two hours, an initial acidity of about 0·085 N/2 acid per c.c. is desirable; while if the time of concentration is three hours, the initial acidity should be about 0·075 c.c. N/2 acid per c.c. A few experiments on the use of kieselguhr and "Norit" for juice clarification in the manner recommended by Dr. F. W. ZERBAN[2] are described.

HAWAIIAN CHEMICAL CONTROL RESULTS (MILLING AND BOILING HOUSE) FOR THE 1921 SEASON. *E. T. Westley.* *Sugar News, 1922, 3, No. 3, 97-100.*

Milling.—Some of the mills have now almost reached the limit of extraction.[3] During 1921 one factory had an average for the season of 99·07 per cent., and nine mills attained over 98 per cent.; while the average milling loss was reduced from 2·75 in 1920 to 2·64 in 1921. Due to a higher percentage of fibre, and a lower polarization in the cane, the average extraction remained the same as the previous year, although the work done was really better, 1·50 per cent. being the average polarization of bagasse for the year—a new record, as 1·56 per cent. was the best previous figure. Two factories lowered the polarization in bagasse to 0·71 per cent. as an average for the season, probably a world's record. On the other hand, the average of one factory (a 5-roller plant) was as high as 4·17 per cent. Moisture in the bagasse was slightly higher than the previous record of 1920, viz., 41·05 per cent. To obtain such a low bagasse polarization a lot of maceration water must be used. One factory reports 54·75 per cent. maceration water on the weight of the cane; the lowest figure reported is 19·41 per cent.; and the average is 39·30 per cent. Another condition that helps in reducing the loss of sugar in the bagasse is the slow speed of the mills and the small tonnage of cane ground per hour. The highest average obtained by any factory was 61·00 tons of cane per hour; this factory being equipped with two sets of knives, one 78 in. crusher, one 72 in. shredder and a 78 in. 15-roller mill.

Boiling House.—One finds that the increase in purity from mixed juice to syrup is dropping from year to year, the high extraction at the mills being, no doubt, to a great extent the cause of this. Fine "cush-cush" passes the mill screens and comes into the boiling house in the mixed juice, and some on dissolving adds impurities to the juices. Sucrose per cent. lost at the filter-presses is about the same as the previous year, an average of 1·66 per cent. for 1921 against 1·65 per cent. for 1920. Coming next to the final molasses, we find that the gravity purity was 38·53, which is very good considering the low purities. Undetermined losses are still very high, the figure being 1·97 per cent. In spite of high extraction, good press and low-grade work, less sugar was recovered from the cane brought to the mill than in any year since 1913. During 1921, 85·86 per cent. of the sugar in the cane was recovered as commercial sugar; but in the last ten years there are only two lower years, the lowest on record being in 1913 when 84·95 per cent. was bagged, and the other was in 1912 when 85·66 per cent. was obtained. During 1913 the extraction was 94·25 and in 1921 the average was 97·43. There is no record of the average final molasses for 1913, but it is sure to have been of a very high purity. We find, therefore, that after a lot of hard work, and the expenditure of hundreds of thousands of dollars to improve extraction and reduce the purity of the final molasses, a smaller percentage of the sugar brought to the mill in the cane is actually bagged than in other years when the extractions were less and the gravity purities of the final molasses were higher. For instance, the year 1914 shows an average extraction of 95·46 per cent., or 1·97 per cent. less than 1921; and the gravity purity of the final molasses was 40·40, or 1·87 higher than 1921. Yet in that year 86·56 per cent. of the sugar in the cane was bagged as against 85·86 per cent. in 1921, or 0·70 per cent. more. What is the reason? The answer is the lower purity of the juice. In 1914 the average first-expressed juice purity was 88·71; in 1921 it was 86·22, or 2·49 lower; and the mixed juice purity in the same year averaged 85·70, but in 1921 it was 82·77, or 2·93 less. The average syrup purity in 1914 was 87·31, while in 1921 it was 83·90, or a drop of 3·41 That we may look more closely into these figures, a comparison is made below:—

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[1] *West Indian Bulletin*, XII, 324.
[2] *I.S.J.*, 1920, 332, 643,
[3] *I.S.J.*, 1922, 194–195.

	1914.	1921.	Increase or Decrease.
Extraction	95·46	95·43	+ 1·97
Gravity Purity of Final Molasses	40·40	38·53	— 1·87
Purity of First Mill Juice	88·71	86·22	— 2·49
Purity of Mixed Juice	85·70	82·77	— 2·93
Drop in Purity from First Mill Juice to Mixed Juice	3 01	3·45	+ 0·44
Purity of Last Mill Juice..	74·96	65·89	— 9·07
Purity of Syrup	87·31	83·90	— 3·41
Increase in Purity from Mixed Juice to Syrup	1·61	1·13	— 0·48
Drop from First Mill Juice to Syrup..	1·40	2·32	+ 0·92
Commercial Sugar Polarization per 100 Polarization of Cane	85·86	86·56	+ 0·70

To the writer these figures show that the high extraction obtained by the present methods lowers the purity considerably; and that one may have 100 per cent. extraction at the mill, and the molasses may be reduced to a very low gravity purity, yet the recovery will be low when the purity of the juice is low. If the energy and money spent on increasing extraction had been spent in trying to get high purity cane in the mills, the writer feels sure that more sugar would have been recovered.

CALCULATION OF THE PROPORTION OF SUGAR DUE TO THE PLANTER IN PAYMENT FOR CANE IN THE PHILIPPINES. *B. Serrano. Sugar News, 1922, 3, No. 4, 156-159.*

A few months ago[1] the author published a simple method of estimating the raw sugar expected from the cane, the calculations giving the piculs of 96·5° sugar per metric ton of cane being as follows:

$$\frac{\text{Sucrose in crusher juice}}{10} + \frac{\text{Purity of crusher juice}-(166-\text{extraction})}{100} \times 2.$$

This method is stated to have given very satisfactory results in practice, the weekly corrections necessary if any being very small, these disparities being due in many cases to a doubtful fibre analysis. Using the control figures of 10 Philippine centrals which were recently published,[2] the following results were found by means of the formula and compared with the yields obtained actually:

	CRUSHER JUICE.		PICULS SUGAR PER TON CANE.	
CENTRAL.	SUCROSE.	PURITY.	FORMULA.	ACTUAL.
6	14·54	81·5	1·67	1·67
5	15·68	82·5	1·79	1·79
1	15·75	82·9	1·69	1·70
4	14·11	84·0	1·62	1·63
2	17·10	85·5	1·94	1·93
7	14·98	79·69	1·67	1·65

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[1] *I.S.J.*, 1922, 46.

[2] *I.S.J.*, 1921, 688.

Review of Current Technical Literature.

INFLUENCE OF THE AMINO-ACIDS OF CANE JUICE IN INHIBITING INVERSION. *J. W. L. van Ligten. Archief, 1922, 30, No. 13, 216-221.*

It has previously been pointed out by WATERMAN[1] that amino-acids are able to prevent or retard the inversion of sucrose by H-ions. Since amino-acids are already present in cane juice, and since further they are formed during the process of manufacture as the result of the decomposition of the proteins, it is of interest to learn to what extent they are capable of exerting their influence, and a number of experiments have been carried out with this in view at the Gending S.F., Java. Two series of solutions were prepared, the first consisting of 50 c.c. of a solution, plus 2 to 10 c.c. of HCl (·0568N), plus water to 100 c.c.; and the second the same with the addition of 10 c.c. of cane molasses solution (13 per cent.), which had previously been neutralized and had been shown incapable of effecting inversion. Observations were made at suitable intervals of time of the rate of inversion of these two series of liquids at different temperatures, viz., 29, 40, 55, 73, and 80°C., an allowance being made of course for the rotation of the added molasses. As the results of these experiments, it was concluded that molasses is capable (owing presumably to its content in amino-acids) of preventing the inversion of sucrose by H-ions at high as well as at low temperatures, or at any rate of greatly retarding this effect.

DETECTION OF SULPHUR DIOXIDE IN SUGARS IN THE PRESENCE OF ULTRAMARINE AND OTHER BLUES[2] *Traugott Bonwetsch. Centr. Zuckerind., 1922, 30, No. 18, 467-468.*

Attention is called to the fact that in determining the presence of SO_2 in samples of white sugar by the test in which reduction is effected with nascent hydrogen, and the formation of H_2S detected with lead acetate paper, the precaution should be taken to remove any ultramarine blue that may have been added while washing in the centrifugals, since this blue also responds to the reaction. 10 grms. of the sugar under examination dissolved in about 30 c c. of water are passed through a thick and close filter-paper, then placed in a small Erlenmeyer flask with 5 c.c. of concentrated hydrochloric acid and a few grains of chemically pure zinc, and the neck of the flask covered loosely with a narrow strip of filter-paper moistened with lead acetate solution If sulphur dioxide is present in the sugar, sulphuretted hydrogen will be formed and the paper browned or blackened. If both the unfiltered and the filtered solutions darken the lead acetate paper, this indicates the presence of ultramarine blue in the sugar in addition to sulphur dioxide. However, it may happen that although the sugar has a bluish shade, no darkening of the lead acetate paper occurs. In this case one may conclude that some other blue than ultramarine has been used, as: indigo-carmin, indanthrene, Berlin blue, or methylene blue. It is stated that the last-named blue mixed with alum is specially produced for sugar factory and refinery purposes, and put on the market under the name of "Pearline."

ACTION OF AMMONIA AND OF AMINO-ACIDS ON DEXTROSE AND LEVULOSE. *A. R. Ling and D. R. Nanji. J. Soc. Chem. Ind., 1922, 41, No. 10, 151-155 T.*

The investigation was undertaken to elucidate the mechanism of the reactions which occur in preparing by the ammonia process caramel for the colouring of beers and spirits. Dextrose combines with excess of ammonia at 35–40°C. to form an additive compound, glucose-ammonia, which reduces alkaline solutions of copper and silver salts, forming a metallic mirror. On heating to about 100°C., however, an exothermic reaction occurs and dark-coloured substances are formed. Glucose-ammonia dissociates in solution, for the specific rotatory power is the same as that of the pure sugar. The sugar obtained from glucose-ammonia consists of a mixture of aldoses and ketoses; in solution it reduces potassium permanganate at the ordinary temperature, a reaction characteristic of λ-glucose. A more vigorous reaction occurs between levulose and ammonia, but the product behaves similarly to glucose-ammonia.

J. P. O.

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[1] *I.S.J.*, 1921, 467.

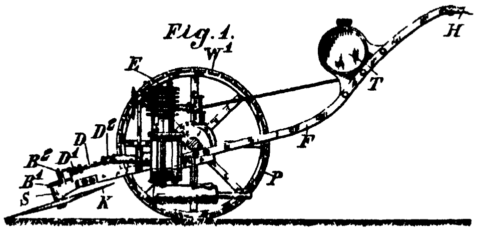
[2] Originally published in *Der Zucker in Russland und im Aus'ande*, Dissertation, Moscow, 1914.

Review of Recent Patents.[1]

UNITED KINGDOM.

Cutting Machine for Cane, etc. *Sir Percy Scott and Archibald F. MacLaren,* of London. *175,759.* November 23rd, 1920.

The object of this invention is to provide a simple, inexpensive but effective device, readily controlled by a single unskilled labourer and adapted for reaping sugar cane or tough grasses (such as elephant grass or papyrus) or for cutting down trees. It comprises the combination with a hand-directed chassis mounted on only two wheels and an internal combustion engine mounted on that chassis, of a cutter that is a high-speed rotating cutter or rotating knife mounted in front of the chassis and so that the plane of rotation of the cutter is approximately horizontal. Said cutter or knife is operatively connected with the engine in such a way that it is run at a high rate of revolution. In practice, the two-wheeled chassis may roughly resemble a lawn-mower, particularly of the motor-driven variety, having the usual handles for guiding and pushing the machine. The wheels are of a nature suitable to the ground over which they will have to move. For example, in a cane-reaping machine the wheels may be large with broad tyres having transverse flanges or projections thereon. In the case of a reaping machine for tough grasses such as elephant grass, the high-speed rotary disc-knife may be arranged horizontally if required, at a suitable distance above the ground level. In the case of a tree-cutting device, the ordinary coned type of disc-knife is not very suitable, but a parallel-sided or flat disc-knife could be used, or a circular-saw. The disc-knife and gearing therefore, and also the wheels, may be mounted on ball bearings.



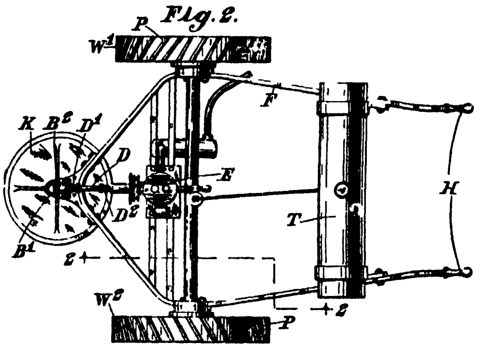


Fig. 1 illustrates mainly in side elevation a reaping or cutting machine for canes or tough grasses, that is constructed according to the present invention; this figure is in section on the line *2—2* of Fig. 2, which is a plan of the same machine. With reference to Figs. 1 and 2, two large wheels W^1 W^2 with broad tyres have transverse projections *P* thereon. These wheels support a frame *F* upon which is fixed a small internal combustion engine *E* supplied with fuel by a tank *T* also mounted on the frame. At the front of the frame or chassis is a shaft *S* borne in bearings thereon and canted slightly out of the vertical. This carries a rotary disc-knife *K* preferably made of high-speed steel and slightly dished or coned, as shown. This knife is driven by the engine through bevel gear wheels B^1 B^2, the latter driven from the engine by a driving shaft *D* with universal joints in it at D^1 D^2. It will be seen from Fig. 1 that the forward or cutting edge of the knife *K* meets the ground at a point just about the ground level; but the frame *F* can be so held, or the knife *K* can be so arranged on it as to cut at a level just below that of the ground. The operator of this machine propels it by means of the handles *H*, whilst the engine *E* runs the knife *K*.

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[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C. 2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2fr. 00 each).

MANUFACTURE OF ACTIVE CHARCOAL (DECOLORIZING CARBON). *W. Carpmael* (communicated by *Chemische Fabrik auf Actien vorm E. Schering),* of Berlin. (1) *178,779.* September 8th, 1921. (2) *179,108.* August 24th, 1921.

(1) Lignite, peat, or a coked product in small pieces is impregnated with (say) a 5 per cent. solution of potassium or sodium carbonate or hydroxide, dried, and heated to "a high temperature, the alkali carbonate then being removed by thorough washing, and the carbon finally dried." In order to increase the activity, the raw material may be subjected to a partial vacuum before impregnation, though in the case of peat the improvement is very little. (2) Wood charcoal is subjected to a partial vacuum, impregnated with an alkali carbonate or hydroxide, heated to a high temperature, and extracted with water. In an example stated, 200 parts by weight of wood charcoal are subjected for half an hour while at 20°C. to a partial vacuum of 720 mm.; impregnated with a solution of 250 parts by weight of potassium carbonate in 250 parts by weight of water, whereupon the charcoal is dried, and heated for about two hours at bright red heat. Lastly, the alkali is extracted from the preferably cool charcoal, which is then dried at 80°C. If caustic alkalis are used, the temperature (it is said) need not be so high as when carbonates are employed.

METHOD OF JUICE EXTRACTION. *Wm. A. Fraymouth, Jas. A. Reavell, and Kestner Evaporator & Engineering Co., Ltd.* *177,820.* October 5th, 1920.

Claim is made for "the process of extracting soluble matter (other than tannin) from powdered or crushed materials, which process consists in first wetting the powdered or crushed material in a wetting zone of a gas-lift agitator, passing a portion of the liquor to the quiescent zone of this agitator and a portion of the liquor and material to an agitated zone of one of any of a group of gas-lift agitators connected in series, such liquor meeting therein a further supply of liquor which latter has passed in succession from the quiescent zone of the first agitator in said series to the agitation zone of the succeeding agitator, and so on in turn through different agitators of the group until it meets the liquor from the main agitator in that member of said group having the stronger liquor, the mixed liquor from the quiescent zone of this member, or from that of a member having strong liquor adjacent thereto, being passed back to the agitation zone of the main agitator, and the liquor finally being drawn off from a quiescent clarifying columnar zone in said main agitator."

PRODUCTION OF YEAST FROM MOLASSES. *R. Gilmour,* of Bloomfield, Belfast. *180,043.* February 17th, 1921.

A light-coloured yeast is produced from molasses by subjecting the molasses liquor to a preliminary treatment with animal charcoal or decolorizing carbon.

BEET-TOP CUTTING AND DIGGING MACHINE. *Svend Th. Olsen,* of Onseveg, Denmark. *179,715.* February 24th, 1921.

This invention relates to digging machines for beets, having means also for automatically removing the tops of the roots prior to digging. It comprises the combination with a stationary top cutting blade adjustable in height by means of a presser foot device effecting contact with the beet tops, of a vertically movable frame disposed longitudinally of the machine, and carrying rods passing through both ends of fixed cylinder which serve to guide the rods and contain springs preventing upward movement thereof. It further comprises the combination with the top-cutting means of a vertically reciprocating member also carried by said frame, and adapted to remove the beet tops.

Cane Cutting and Harvesting Machine. *Max Wertheim*, of Hampstead, London. *174,516*. December 29th, 1920.

In apparatus for harvesting sugar cane, etc., as described in the inventor's previous specifications 156,298[1] and 164,229,[2] the felling cutters are suspended in such a way that they may rise vertically and tilt laterially and forwardly and rearwardly, so as automatically to follow undulations in the ground and effect a close cropping of the canes, etc.

Preparation of Absorbing Medicinal Carbon from Decolorizing Carbon. *J. N. A Sauer*, of Amsterdam, Holland. *174,702*. October 26th, 1920.

A neutral absorbent product for sanitary, medicinal, and therapeutic use (either internally or externally) is prepared from high-class decolorizing carbon of vegetable origin by washing with volatile acid and with alkali, either being used first, to remove mineral ingredients, and then heating to incandescence. Hydrochloric or nitric acid may be employed, and if the alkali treatment comes last, an alkali which forms volatile salts, for example ammonia, should be used. The carbon is ground in such manner as not to destroy its microscopic cellular structure. It may then be compressed into coherent form, such as pills or tablets, with the use of a water-soluble organic binder such as cane sugar or lactic sugar. (Specification 155,610[3] is referred to.)

Cane Harvesting Machine. *Elko Botje*, of Doerabaia, Java. *4670*. February 2nd, 1920. (Four figures; three claims.)

Cane Harrow. *Gebroeders Stork en Compagnie*, of Hengelo, Holland. *4813*. March 10th, 1920. (Two figures; one claim.)

Electrolytic Purification of Cane Juice.[4] *Elie Delafond*, of Habana, Cuba. *178,488*. December 6th, 1920.

Motor Fuel containing Alcohol and Acetylene. *S. W. Blake*, of Oudtshoorn, South Africa. *178,498*. December 16th, 1920.

A motor spirit is produced by agitating say 3–5 lbs. of calcium carbide in a pressure-resisting vessel with say 9 gallons of commercial alcohol and say 1 gallon of acetone, and allowing the mixture to stand with occasional shaking until the acetylene is absorbed. The liquid is cleared from the bulk of the lime by carbon, manganese dioxide, or other insoluble flocculating agent. A fuel of the composition specified contains over 12·5 times its volume of acetylene,[5] and 0·025 to 0·05 per cent. of lime.

Refractometer of the Abbe Type. *William Taylor*, of Stoughton Street Works, Leicester. *178,290*. March 17th, 1921.

According to this invention, the position of the reader is fixed in a position convenient for observation, the graduated arc being attached to the pivot of the prisms so that the arc moves therewith. Preferably instead of using a rack-and-pinion to move the arc a screw or equivalent means is used to turn the arc and the prisms together against the action of an elastic pressure means, such as a springer weight, thereby eliminating the back-lash, the screw or its equivalent being such as to be immovable under the action of the said pressure means alone.

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[1] *I.S.J.*, 1921, 298. [2] *I.S.J.*, 1921, 592.

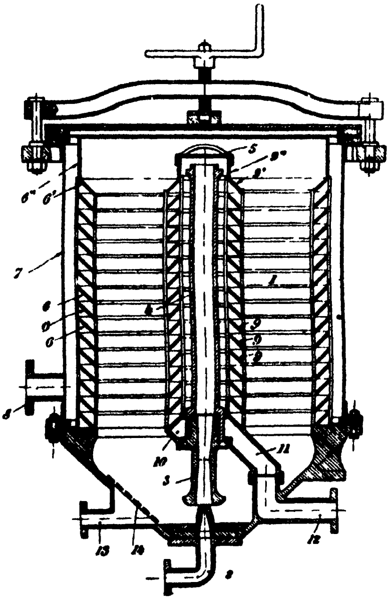
[3] Taken out also by J. N. A. Sauer, the claim of which reads: "The process of sterilizing and simultaneously purifying water, which consists in treating the same with decolorizing carbon in a fine state of subdivision, which carbon has been previously subjected to the action of acids or alkalis or to high temperature or to two or all of said actions substantially as described." See *I.S.J.*, 1921, 234.

[4] See also U.S. Patent, 1,371,997; *I.S.J.*, 1921, 418. [5] See also *I.S.J.*, 1921, 537.

UNITED STATES.

Sand Filter for Juices and Syrups. *Louis E. Raimbert*, of Paris, France. *1,410,121.* March 21st, 1922.

This invention relates to sand filters of the type in which an annular sand chamber is combined with a tubular central member for the passage of the sand into a washing basin, an injector for the water under pressure being placed in the lower portion thereof for injecting the water which draws the sand with it from the annular chamber into the central tube, and from here into the washing basin. In the type described the annular chamber for the sand is limited both at the interior and the exterior by two series of superposed conical rings. This arrangement of double rings does not constitute a simple repetition of a well-known device, but in the present instance particular results are obtained in that it is possible to extend the field of the use of the sand filter to industries in which filters hitherto constructed of a single series of rings could not be applied.



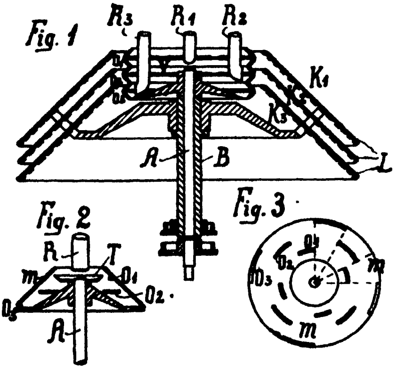
Referring to the drawing, *1* is the annular sand chamber, *2* is the inlet for the water under pressure, *3* is the injection cone for the sand which mixes with the water, *4* is the central tube for causing the sand to pass into the washing basin by means of a device (not shown) provided at the upper end of *4* Normally the central tube *4* is closed or surmounted as shown by a cover *5*. A series of superposed conical rings *6*, *6*, of which the upper ring *6'* is provided with a cylindrical casing 6", forms the outer bearing surface for the sand enclosed in the chamber *1*, and between this series of rings and the outer wall *7* of the filter is provided a free space in which terminates a tubular inlet *8*. An inner series of smaller conical rings *9*, of which the upper ring *9'* is also provided with an upward cylindrical extension *9''*, limits the annular chamber for the sand towards the centre, and between this inner series of small rings and the plain central tube *4* is provided a free space communicating by the annular space *10* and a tubular member *11* with the tubular outlet *12*. At *13* is a tubular discharge member from the sand chamber; *14* is a perforated plate supporting the sand above the edge of the tubular member *13* provided at the lower end of the sand chamber. It will be understood that the reverse arrangement may be adopted, the liquid to be filtered being preferably effected in the exterior annular portion between *6* and *7* through a tubular member *8*, the outflow taking place between *4* and *9* through tubular members *11*, *12*, this admission of the liquid through the exterior affording the advantage of supplying to the liquid at the end of the operation, that is to the liquid which is the most charged with impurities, the larger filtering surface in consequence of the larger surface of the outer rings. In order that when the liquid in the filter rises to an abnormal level above the sand it is prevented from passing directly over the upper ring *9'* into the space reserved for the filtered liquid, the upper ring *9'* has been provided with a plain extension or cylindrical casing *9''* rising to a sufficiently high level and closed by the cover *5* so that the liquid cannot pass over it in any case. For a similar reason the upper outer ring *6'* is also provided with a cylindrical extension *6''* rising sufficiently high so that the liquid cannot flow over it. The sand rises between the casings *6''* and *9''* to a height sufficiently above the annular passage between the two upper rings so that the liquid preferably flows between the central rings rather than rises above the cover *5*. The cover *5* also prevents the penetration of the sand into the central part whilst the filter is being charged and facilitates its distribution in the annular chamber.

MOTOR FUEL CONTAINING ALCOHOL. *Elbridge W. Stevens* (assignor to *Chemical Fuel Company of America, Inc.*, of Louisville, Ky., U.S.A.). *1,414,759.* May 22nd, 1922.

Claim is made for a motor fuel of the same general character as gasoline, consisting of "a petroleum distillate, alcohol, a hydrocarbon blending agent, and a small amount of a readily volatile formic acid ester."

CENTRIFUGAL MACHINE WITH CONE OR WING-SHAPED SURFACES. *Otto Pankrath*, of Raunheim, Main, Germany. *1,387,661.* August 16th, 1921.

Continuously acting centrifugal machines with cone-shaped or wing-shaped centrifugal surfaces have all hitherto suffered from the drawback that the massecuite is not uniformly dried, or that their capacity is unsatisfactory. According to the present invention, these drawbacks are overcome by the arrangement of a device which, while acting itself in a centrifugal way, supplies or throws the material to be treated in thin layers and in a uniform distribution upon the centrifugal surfaces of the machine. Depending on the extent of distribution intended, the device may be modified in its details.



Referring to Fig. 1, the cones K^1, K^2, K^3 are keyed on the hollow axle *B*. Through the latter passes a rotary shaft *A*, which carries the distributor *V* and which receives a different circumferential speed to that of the axle *B*. The massecuite flows through three pipes R^1, R^2, R^3 to the three superposed compartments of the distributor *V* and is thrown on to the cones *K* through the three annular slots O^1, O^2, O^3 in said distributor. The cones *K* are fitted with strainers upon which settle the crystals; while the syrup is collected on the cone surfaces and escapes through the bottom openings *L*. The supply to the pipes *R* can be easily controlled in such a way that all three compartments of the distributor *V* and thus all three cones *K* receive equal quantities of massecuite. From the slots *O* of the distributor, the massecuite is thrown in tangential direction, whereby all lumps are divided into crystal size, and, owing to the different speeds of shaft *A* and axle *B*, are still further spread upon the cones *K*. The greater the difference between the speeds of shaft *A* and axle *B*, the finer and thinner is the massecuite distributed upon the cones, and the more can be supplied and sufficiently thrown out. The capacity of the cones *K* depends thus upon the efficiency of the distributor *V*. If the cohesion of the massecuite lumps is very large, it will require a stronger effect of the distributor than *vice versa*. In this case, behind the first distributor, a second and third distributor can be inserted, and each distributor can be designed as a drum with strainers, so that the massecuite is not distributed and spread at a time but in stepwise fashion. For instance, on the hollow axle *B* a second hollow axle of different speed to that of axle *B* may be mounted and also fitted with three cone-surfaces, which, of course, are so large that the massecuite from the cones *K* can be delivered upon the same.

In Fig. 2, the distributor is cone-shaped. The massecuite from the cup *T* underneath the pipe *R* is thrown upon the walls of the cone *M* and flows down the same. As shown in Fig. 3, the walls of the cone *M* are interrupted by three rows of alternately arranged slots O^1, O^2, O^3, of which the uniform arrangement and width results in a correspondingly uniform distribution of the massecuite upon the cones K^1, K^2, K^3. For this purpose, the cone surface *M* (Fig. 3) is divided into twelve radial sections of equal size, of which always each three succeeding sections at three different distances from the centre have slots O^1, of which the width corresponds to the width of the section at the respective place of the cone surface *M*. Now, the three slots are arranged four times, giving together twelve slots. Owing to this division, all the slots allow a passage of approximately equal quantities of massecuite therethrough, and furthermore that quantity which is not taken up by the slots of row O^1 must flow either through those of row O^2 or O^3. Of course the slots *O* may also be dimensioned and distributed in any other way. The object of the division described is to supply all three cones *K* as far as possible with equal quantities of massecuite and uniformly spread the latter upon each single cone *K*. Distributors of other forms are also described in this specification.

CANE STRIPPER AND TOPPER. *Henry O. Scranton*, of Jeanerette, La., U.S.A. *1,133,187*. March 9th, 1920.

A device is described for removing the leaves from canes after they have been cut down, and also for removing the upper end portions. It consists of portable stripping and topping mechanisms which are actuated by a suitable motor as hereinafter fully described and claimed. As is shown in Fig. 1, the machine is provided with a frame *2*, which is mounted on ground wheels *3*. This frame may be attached to the rear end of a cane harvester of any approved construction, and it is provided with a table *4* or other suitable support at its front end for receiving the canes. Cutters *5* are supported by a plate *6* arranged a little to the rear of the table, and as many cutters as desired can be used. Cutters *5* are arranged in a row and are substantially tubular; they may be cylindrical, or of any other suitable shape or cross section, and they are provided with sharp cutting edges at their front ends. Rollers *7* (seen in Fig. 3) are arranged below and behind the cutters *5* and are secured on a shaft *8*, journaled in bearings *9*, and driven by any suitable motor, as a gasolene engine. Rollers *12* are mounted to revolve over the rollers *7*, and the rollers *7* and *12* are grooved or are otherwise constructed so that they will grip the canes tightly. The upper rollers *12* are journaled in bearings *14* on springs *15*, which are secured to a support *16*, and provided with pressure adjusting screws *17*. If desired, all the rollers may be driven positively by the motor, or additional rollers or pairs of rollers may be placed behind the rollers *7* and *12* to assist them in dragging the canes through the cutters. Rollers *7* are driven at a relatively high speed so that the cane is pulled rearwardly and is discharged from between the rollers with considerable force. The canes are thrust into the cutters by men who stand on platforms at each end of the feed table, and the smaller end portions of the canes are seized by the rollers behind the cutters. A bumper or stop plate *20* is arranged at the rear end of the machine, and the canes strike against this bumper as they are shot from between the rollers *7* and *12*. The canes fall upon an endless conveyor *21* of approved construction, which is arranged to travel crosswise of the

FIG. 1.

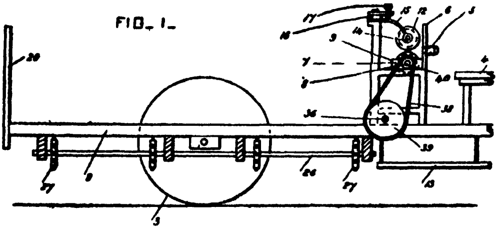
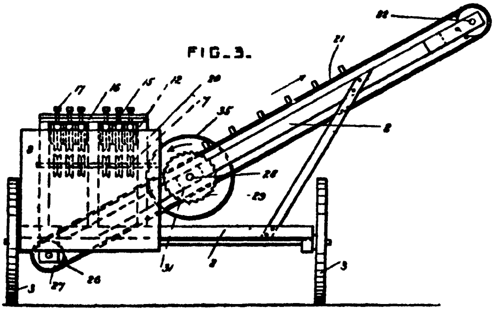


FIG. 3.



machine in the space between the cutters and the bumper. The conveyor *21* is provided with a driving shaft *22* which is driven from the motor by an endless flexible connexion. The lower end portion of the conveyor is supported by a shaft *26* and wheels *27*, and the conveyor is arranged in a suitably inclined position so as to discharge the canes from its upper end into a suitable cart or other receptacle. A topping saw *29* is provided for cutting off the upper end portions of the canes. This saw is arranged to one side of the lower portion of the conveyor, near the bumper, and is secured on a saw shaft *28* journaled in bearings *31* on the frame. The saw shaft is coupled to the shaft *8*, by means of bevelled toothed wheels, or other suitable driving devices. The motor shaft is connected to the saw shaft *28* by a flexible driving connexion and wheels. One of the bevelled wheels is secured on a countershaft journaled in bearings on the frame, and the other bevelled wheel is secured on the saw shaft. The roller shaft *8* is driven from the countershaft by a flexible driving connexion *38* and wheels *39* and *40*, but any other approved driving devices may be used between the different shafts of the machine.

Continuous Clarifying Machine.[1] *Gustav ter Meer*, of Hanover, Germany. *1,408,843*. March 7th, 1922.

Claim is made for a centrifugal machine having an end wall and a peripheral wall, means for effecting an endwise movement of one of the walls to permit of the radial discharge of material from said chamber, said walls having contracting seating surfaces and means for protecting said surfaces during the discharge of the material.

Beet Juice Extraction Apparatus.[2] *Sir John I. Thornycroft*, of Bembridge, Isle of Wight. *1,409,797*. March 14th, 1922.

Supporting Spindle for Centrifugal Machines. *Meredith Leitch* (assignor to *The De Laval Separator Co.*, of New York, U.S.A.). *1,409,958*. March 21st, 1922.

Beet Harvesters. (1) *Alfred G. Bimson*, of Berthoud, Cal., U.S.A. *1,410,880*. March 28th, 1922. (2) *Morgan A. Greene*, of Rupert, Idaho, U.S.A. *1,411,015*. March 28th, 1922. (3) *Ole Hansen*, of Menan, Idaho, U.S.A. *1,416,196*. May 16th, 1922. (4) *Chas M. Ewing and Herbert N. Bryan*, Deweyville, Ohio, U.S.A. *1,417,309*. May 23rd, 1922. (5) *Wm. R. Carlson*, of Warrenton, Oreg., U.S.A. *1,408,986*. March 9th, 1922.

Beet Toppers. (1) *Elvin B. McCain*, of Hershey, Nebr., U.S.A. *1,412,696*. April 11th, 1922. (2) *Stephen A. Goodson*, of Hillsboro', Ill., U.S.A. *1,420,482*. June 20th, 1922.

Beet Digger. *Peter J. Boyle*, of Saginaw, Mich., U.S.A. *1,421,123*. June 27th, 1922.

Centrifugals. (1) *Seldon H. Hall* (assignor to *The De Laval Separator Co.*, of New York, U.S.A.). *1,411,782*. April 4th, 1922. (2) *Harry H. Stephens* (assignor to the *Gillespie Motor Co.*, of Paterson, N.J., U.S.A.). *1,412,145*. April 11th, 1922. (3) *Eugene Roberts* (*Western States Machine Co.*, of Utah, U.S.A.). *1,414,526*. May 2nd, 1922.

Filters. *James H. Fleetwood*, of New Orleans, Louisiana, U.S.A. *1,412,557*. April 11th, 1922.

Pumps. (1) *Hans Eicheler*. *1,412,105*. April 11th, 1922. (2) *Melvin B. Eslinger* (*Tornado Auto Pump Co.*, of St. Louis, Mo., U.S.A.). *1,412,279*. April 11th, 1922.

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[1] See also *I.S.J.*, 1921, 585.

[2] See also U.K. Patent, 120,448; *I.S.J.*, 1919, 146.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1922. Tons.	1921. Tons.
Total Receipts, January 1st to August 9th	49,922	88,621
Deliveries ,, ,,	2,675,724	1,664,761
Meltings by Refiners ,, ,,	2,540,863	1,575,844
Exports of Refined ,, ,,	700,000	196,000
Importers' Stocks, August 9th	60,119	3,755
Total Stocks, August 9th	197,285	122,179
	1921.	1920.
Total Consumption for twelve months	4,107,328	4,084,672

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1919-1920, 1920-1921, AND 1921-1922.

(Tons of 2,240 lbs.)	1919 20. Tons.	1920-21. Tons	1921-22 Tons.
Exports	2,590,502	1,510,416	2,377,510
Stocks	605,308	1,416,943	844,622
	3,195,810	2,927,359	3,222,132
Local Consumption	47,700	64,000	75,000
Receipts at Ports to June 30th	3,243,510	2,991,359	3,297,132

Havana, June 30th, 1922 J. Guma.—L. Mejer.

Beet Crops of Europe.

(Willett & Gray's Estimates to August 10th, 1922.)

	Harvesting Period.	1921-22. Tons.	1920-21. Tons.	1919-20. Tons.
Germany	Sept.-Jan.	1,330,000	1,152,960	739,548
Czecho-Slovakia	Sept.-Jan.	659,907	705,919	493,781
Hungary and Austria	Sept.-Jan.	68,322	47,977	12,151
France	Sept.-Jan.	275,000	305,041	154,444
Belgium	Sept.-Jan.	300,000	242,589	146,918
Holland	Sept.-Jan.	370,000	316,402	238,692
Russia (Ukraine, Poland, etc.)	Sept.-Jan.	100,000	89,071	78,013
Poland	Sept.-Jan.	225,000	189,834	140,000
Sweden	Sept.-Jan.	227,000	164,194	145,072
Denmark	Sept.-Jan.	145,000	134,835	152,852
Italy	Sept.-Jan.	200,000	135,484	182,843
Spain	Sept.-Jan.	135,000	170,722	81,650
Switzerland	Sept.-Jan.	5,500	3,710	8,550
Bulgaria	Sept.-Jan.	22,000	7,837	10,974
Rumania	Sept.-Jan.	25,000	5,000	....
Total in Europe (1922-23, 4,500,000)		4,087,729	3,671,575	2,585,488

Sugar Market Report.

Our last report was dated 11th July, 1922.

Values ruling to-day show an advance upon those quoted in that report, but the tendency is easy, and already the reaction from the highest prices reached is substantial. Greater trade activity had helped to impart confidence to the market, and the more distant positions, previously neglected, had shared in the attention of buyers. Good quantities of Czecho-Slovak superior sugars for Nov./Dec. delivery were sold at from 21/6 to 22/7½ f o.b. Hamburg, and Belgian Crystals and Dutch Granulated in smaller proportion at advancing prices The steady demand for raws on the part of British and American Refiners and a certain amount of speculative support, served to support the basic markets; Cuban centrifugals advanced to 3⅞ cents c & f New York, and 19/6 c.i.f. was paid for several cargoes for U.K. and Continental destinations. The first signs of weakness were shown in the New York market upon the publication of news that the Senate had voted *an increase in the rates of duty from 1·60 c. to 1·84 c.* per lb. on Cubans, and *from* 2 c. *to* 2.30 c. per lb. on full duty sugars. Although the formalities necessary to make the new tariff operative (if ever it become operative), are likely to take a considerable time, there was a tendency to sell on the part of holders who had been hoping to get 4c. c & f for their sugars, and stored lots particularly began to be pressed on the market. The London market had in the meantime freely absorbed offerings of White Javas c.i.f., at prices advancing into the neighbourhood of 22/3 for July and 22/- for August shipment c.i.f. London, such purchases being held more on speculation than for actual trade orders. The reaction which set in has consequently been made more acute by the pressure of these sugars, which are to-day offered at 20/3 c i.f. July, and 20/1½ August shipment. American granulated after being done up to 24/9 c.i.f., is now quoted 24/- for August shipment, 50/- spot, duty paid; F.W. Belgian Crystals 20/6 f.o b. Antwerp Oct./Dec. Czecho-Slovak superior granulated TTD, SCH, etc., Nov./Dec. not offered by first hands, but value about 22/- f.o.b., Tate's No. 1. Cubes 59/3, London Granulated 52/3 spot, duty paid.

The outturn of the current Cuban crop is now estimated by Messrs. Willett & Gray at 4,000,000 tons, and general opinion favours the figure of 3,500,000 tons for the next crop. European reports point to satisfactory progress, and an excess of some 400,000 tons over last year is looked for, given continued favourable conditions. Otherwise the outlook for next year is not materially altered, and the possibilities of the prospective supply and demand become more interesting as the present downward movement progresses.

In Mauritius Crystals further business has been done to U.K. Refiners; a cargo for September was sold at 24/6 and one for October at 23/10½. The Syndicate is at present holding for 24/- c.i.f. which is above the parity of this market.

Considerable activity has been seen in the Java market, where the Trust have moved large quantities to shipping merchants and speculators. There have been moments when India appeared likely to come in again as a buyer, and some few thousand tons were bought, apparently in anticipation of this demand, up to 21/6 c & f Calcutta basis; but sellers who maintained their prices until the last few days have at last followed the general trend of the market and Oct./Dec. c & f Calcutta can now be bought at 21/. Sales of about 50,000 tons for early new crop shipment are reported to have been made by the Trust at 13¼ guilders, equal to about 19/6 f.o.b.

Total shipments from Java during July were 248,753 tons, and the following table shows the destinations and quantities compared with the same period last year :-

	1922		1921	
U.K./ Continent	99,995	....	20,875	
Port Said for orders	22,777	....	12,700	
British India	49,850	....	93,000	
Japan	28,960	....	34,725	
Vancouver	6,982	....	—	
Elsewhere	40,189	....	35,135	
Total	248,753	....	196,435	Tons.

H. H. Hancock & Co.

10 & 11, Mincing Lane,
London, E.C. 3,
August 23rd, 1922.

THE INTERNATIONAL SUGAR JOURNAL.

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☞ The Editors are not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

The Outlook.

The prospect for the sugar industry the coming cane season continues to look much more favourable than was hoped for six months ago. Prices have risen to a more remunerative figure and the slight fluctuations of the market of late have no significance as regards the general outlook. The deciding factor is, of course, the increasing world's consumption, which is particularly marked in the United States, and is definite if less extensive in Great Britain. In England the fruit crop is proving abundant and very cheap, so that domestic and trade fruit preserving is being extensively undertaken this year. It is alleged in some quarters that the increased absorption of sugar the past six months is no more than a replenishment of exhausted invisible supplies; but whatever may be the case on the Continent, we question whether that view can be substantiated as regards Great Britain and the States. Anyhow, the reports of consumption for the last half of 1922 will be received with some interest, for they should go some way to prove or disprove this contention.

WILLETT & GRAY'S last estimate of the World's sugar crops (reproduced on another page) indicates a European beet crop of 4,500,000 tons this season, or fully 300,000 tons more than last year; but our Continental correspondent inclines to the view that the amount in spite of the splendid conditions of the beet fields will not exceed 4,417,000 metric tons. The final result will depend to some extent on how far the unrest of Europe is alleviated by the International statesmen concerned with the task of pacifying Continental nationalities, and solving their economic difficulties. Any economic catastrophe on the Continent this fall would probably not only add to the difficulties of harvesting the beet crop and marketing it, but would also ruin the market for sugar in the territories concerned. Russia is a cardinal instance of what economic ruin involves. There we find not only an inability to produce any appreciable sugar crop under Soviet conditions, but it is clear that if they had the sugar the population would be unable to afford to purchase it; even foreign sugar, cheap by comparison, is beyond their purse.

Germany has however been vouchsafed a breathing space for six months, so it may be taken for granted that her beet crop is safe this season. That of France will prove one of the largest on record for many years.

The American Tariff.

It still remains to be seen whether the American sugar tariff as amended by Senator Smoot to 2·30 cents a lb. for foreign and 1·84 cents for Cubans will finally pass the Senate and receive the President's signature. The domestic sugar interests are all in favour of this marked increase in the tariff, while New York and the refining houses generally look on the proposal with disfavour in that it will affect the market in Cuban sugars. The opponents of the measure point to the alleged enormous sums the American public will have to pay for their imported sugars under the increased tariff. But, as an article we published last month from an American source showed, it does not follow that the import tax is passed on to the consumer; it may come out of the pockets of the foreign producer, at all events till the tax becomes an excessive percentage of the cost of the sugar itself. Whether that stage has been reached in the Smoot proposals is a point on which opinions will differ; but our view is that the emergency tariff was at a reasonable level and achieved all reasonable protection to the domestic production. If the Smoot tariff comes into force, we fear the American sugar consumption will suffer a relapse. Either the American public will pay the tax, in which event it will find sugar too dear to buy as freely as hitherto; or else the Cuban producer finding he can only get into the market by paying the heavy duty may decide that it is not worth while selling sugar at a loss to American customers and will accordingly reduce production. If this reduction could be made up by the domestic interests (Louisiana and the Beet States) no harm would perhaps accrue to the American consumer; but we do not suppose those domestic sources could tackle a fraction of the increased production requisite to supplant Cuba on the United States market. So we fail to see that the Smoot rate is an advantage either to the sugar industry generally or to the American consumer, and we would express the hope that a less drastic rate of taxation may finally be passed into law.

The Sugar Industry in Natal and Zululand.

There is no doubt that there is, as elsewhere, a serious crisis in the South African sugar industry. The conditions are, however, unique, and some of them are referred to in our notice elsewhere in this issue of the Report of the Sugar Enquiry Commission, Union of South Africa, which has just been published. In the first place we must remember that, as in Queensland and Louisiana, sugar cane is being cultivated outside the limits of its best growth. These are cases of countries, chiefly warm temperate, with a small sub-tropical region in which it has been thought worth while to build up an indigenous source of sugar for the consumption of the great masses of population which inhabit the cooler parts where the sugar cane cannot be grown; and this has only been possible by a series of tariff measures of a protective nature. In Queensland the tendency is for the cane growing area to thrust itself further north where a small and fertile tract is met with in the tropics, in Louisiana the possibility has been broached of transferring the industry to Florida where the sugar cane is more at home, and in Natal a recent advance has been made into warmer Zululand. In each case the industry may be said to hold a precarious existence and to depend upon the action of a Government representing a preponderating mass of consumers who could probably get their sugar cheaper elsewhere. But a great deal of capital is locked up, and a considerable number of leading men are interested in the industry; it has been laboriously built up by the Government, and any sudden closing down would be a very grave step.

Two important expansions have occurred in the development of the industry in South Africa, from 1905-10 owing to the opening up of the Crown lands in

Zululand, and after 1918 when the price of sugar was abnormally high all over the world. The effect of the Zululand extension is now being felt, in that the supply exceeds the requirements of the Union, and the export period has commenced. But with the low prices obtaining now it is found, as was to be expected, that the costs of production as compared with more favoured tropical sugar-growing countries are very high. It is estimated that in the matter of import duties alone the country is giving a bounty to the industry of £450,000 a year. Foreign sugars are knocking at the door and can only be kept out by strong measures, while the jam and confectionery industries, also approaching the export stage, are enemies within the gate (as in Australia) and are clamouring for freedom of import. In these circumstances any attempt at export of the surplus of South African sugars has met with very heavy losses, this time borne entirely by the industry. Sugar production in the Union reached the surplus stage in 1919 and no difficulties were experienced, while the prices were higher than that in the Union ; in fact, an excess profit on export of £433,047 was made by the industry and equally divided between the millers and planters. But when the price fell, the reverse was the case, and the loss on the various grades of exported sugar in 1920-21 was nearly £600,000. This was borne entirely by the millers, for the planters, while pocketing half of the excess profits with equanimity, refused at once to share the losses. This reveals the facts that (1) cane farming has taken a strong hold in the industry, as is the case in all the Zululand extensions, and (2) the agreements between planters and millers are in urgent need of revision. With the obvious dilemma in which the industry finds itself we hesitate to deal. The task of examining these agreements has occupied the bulk of the Commission's time, and some of the anomalies in them are discussed in another part of the Journal. Special attention is also devoted there to the fact which has emerged that the cane universally grown, the Uba, has a good deal to do with the matter. It is not usually regarded in other cane-growing countries as suitable for sugar making. It, however, needs little care in cultivation, and this appears to have been taken full advantage of by the planters. In the mills, on the contrary, although its excess of fibre may have solved the fuel question, it is found hard to crush, and the excess of fibre, coupled with a large amount of gummy substance in the juice, cause much trouble in the manufacture of sugar. We invite the attention of those interested to the suggestions made as to the unsuitability of the Uba cane to the lower levels of Zululand and the possibility of replacing it by other varieties.

The West India Committee.

The West India Committee, which has for many years past, under its very able secretary, Mr. A. E. ASPINALL, C.M.G., carried on an extraordinary amount of miscellaneous work in somewhat cramped quarters at Seething Lane, E.C.3., is about to move to larger and more commodious premises in the same quarter of London, where we trust it will find more space for its activities. For many years it has served as the unofficial go-between twixt the commercial community in the British West Indies and the Colonial Office in Downing Street, and has held a close "watching brief" on their behalf in a great variety of political and commercial matters. Our readers of bygone years will be aware from our past pages of the considerable extent to which this Association worked for the abolition of sugar bounties and the amelioration of the British sugar industry. Sugar has been their staple crop interest, and they have had a large share in the success that has crowned of late years the long sustained effort to get a preferential tariff in this country for British sugar. The war threw on Mr. Aspinall and his Committee a great deal of extra work and responsibility, mostly of a necessarily unremunerative nature, since the contingent that came to the war from the West Indies naturally looked to Seething Lane as their club and their *vade mecum*, and they did not look in vain.

But since rightly or wrongly, when the cost of living and maintenance went up, the West India Committee decided not to increase the rate of their annual subscription (which included a free copy of the fortnightly *Circular*), it became inevitable for an endowment fund to be raised. The amount aimed at was £20,000, but to date nearly £24,000 has been secured by means of donations from all over the world, but chiefly of course from West Indian commercial and professional interests. With the income from this capital it ought to be possible for the Committee to face with some equanimity the much greater expenditure involved in acquiring and maintaining larger premises; but this does not lessen the necessity for the West Indian community, in its various branches of trade and industry, to give increased support by means of membership subscriptions (if not donations) to an Association which has its interests so completely at heart and may be relied on to use its utmost influence in political quarters to ensure a continuance of the preferential benefits that have lately accrued to these colonies. Benefits, however, must justify their bestowal, and we venture to suggest that not the least important method of supporting the representative body at home is a lively sense of enterprise and perseverance in the colonies themselves to run their industries on the most up-to-date and scientific lines, particularly in view of the excellent example in this respect set by the neighbouring American territories with their identical industries. But we think a realization of this by those concerned is steadily developing.

Steam Turbines in Cane Mills.

G. Lobo of the Kelvin Engineering Company contributes to *Facts about Sugar* a short article on the advantages of steam turbines in sugar house practice. According to him, there is at the present time in Cuba hardly any factory that is not using at least one steam turbine and in many of these factories the only prime movers installed are of this kind. In a completely electrified sugar factory, that is one in which even the rolling mills are electrified, it is universal practice to instal steam turbines, some of the larger plants having a total capacity of as much as 8000 kilowatts. In partially electrified factories where the cane mills are driven by the usual Corliss engines, all the pumps and other auxiliaries are driven by electric power from turbo-generators. In factories where they do not have even partial electrification steam turbines are often used to drive such auxiliaries as boiler feed, injection and water supply pumps.

This preference for steam turbines Mr. Lobo ascribes to several causes. Foremost amongst these is the simplicity of the turbine and the ease with which unskilled operators learn to take care of it properly. A second advantage is the small amount of space required in comparison with that which is taken by a large steam engine. A third advantage is the reduction in the first cost which in some cases is considerable. A fourth is the possibility of controlling the speed of the crusher and each of the mills independently of each other. Other advantages are the comparative freedom from oil in the exhaust steam which is utilized in the evaporating plant and lack of attention required by the electrically driven auxiliaries —a motor driven centrifugal pump for instance once started requires scarcely any attention whereas a steam-driven pump has to be constantly watched. The only disadvantages that are occasionally charged against the turbines are their higher steam consumption and the possibility of wear in the rotating element and other parts of these high speed machines. But the higher steam consumption is not of importance in a sugar factory where the evaporating plant can always be designed so that all the steam produced by the burning of the bagasse in the boilers is first passed through the prime movers and then used in the evaporating plant without the necessity of burning extra fuel in the generation of steam; and there is no advantage in saving bagasse.

As regards wear and tear, it should be taken into consideration that the steam turbine contains no reciprocating elements but only one rotating member, which is perfectly balanced and does not cause vibration or alternating stresses of any kind. Hence heavy foundations are not required. There are no rubbing surfaces except the simple bearings which receive lubrication automatically. Nor are there any packings except the shaft ones, or piston rings, or valve gear except a governor gear. The only parts which ever require replacement are the steam nozzles, wheel buckets, and shaft packings, all of which are light simple parts easily ordered from the makers and interchangeable. Finally, there is no reboring of cylinders or resurfacing of valve seats, as is the case with the reciprocating engine.

British Empire Patents: A Conference Proposal.

Between 12th and 23rd June last a Conference of representatives of Patent Offices in the Dominions (except Newfoundland), India, and the Colonies and Protectorates, was held at the Patent Office, London, under the chairmanship of Mr. TEMPLE FRANKS, C.B., Comptroller General. Its purpose was to consider the possibility of instituting a practical system of granting patents which should be valid throughout the British Empire. At present to obtain a patent in all parts of the Empire at least 46 separate applications have to be made and initial fees paid of £5 in the United Kingdom, £32 in the Dominions and India collectively, and about £250 for all the Colonies and Protectorates. Renewal fees amount to £126 for the United Kingdom, £84 for the Dominions and India collectively, and approximately £1000 for the Colonies and Protectorates. The Conference found that this system was very unsatisfactory and unanimously agreed that it was desirable, provided that the autonomy of the self governing Dominions and of India was preserved and the existing rights and facilities of inventors were not affected, to institute a British Empire Patent as a means of cheapening cost and simplifying procedure.

After a long discussion a scheme was drawn up and adopted. It was agreed that the existing rights of the different governments within the Empire to grant patents according to their own laws and within their own territories be maintained in full. A central Patent Office should however be established for the reception and examination of all applications for, and grant of, patents which shall extend to the United Kingdom or to any of the self-governing dominions or to India on registration in the particular territory in which protection is desired, the application being open to opposition before registration is actually effected. The central Patent Office would make one search only co-extensive with the field covered at present by the several searches that have now to be made. The fees for registration to be of such an amount as to reduce considerably the total cost of obtaining patents throughout the Empire.

If this scheme were given effect to, it would result in only one application and one specification being necessary to obtain the grant of a patent throughout the

Empire. Likewise only one examination in respect of formalities, sufficiency of the documents, and the novelty of the invention would be needed. In consequence, a very great diminution in expense will be affected, while a patent so granted and registered would have a considerably greater commercial value than any individual patent at present issued in the British Empire by reason of the wider search that would be made at the Central Office. It would also encourage applications for Patents in other parts of the Empire.

But the Conference while devising a scheme that had the greatest chance of success and acceptance throughout the Empire, realized that the equipping of a central office would take considerable time and expense, and hence they adopted a provisional scheme to serve as a temporary expedient till the main scheme could be given effect to. Under this the existing rights of the several territories to grant patents under their own laws would be maintained in full; but any patent obtained by examination and grant in the United Kingdom would be extendable to any of the self-governing dominions or to India on registration in the particular territory in which protection was desired, such registration to be open to opposition or to any lawful objection that the local patent office may think fit to raise. The scheme would be applicable likewise to any of the colonies and protectorates subject to the demands of the local requirements and administrative machinery.

The outlines of the procedure necessary to carry out the provisional scheme were then discussed and agreed. The Conference was of opinion that whether or not the proposals suggested for a British Empire Patent be found practicable, it is of the highest importance that both the procedure and practice in respect to the grant of patents should be uniform throughout the British Empire.

Second Estimate of the 1922-23 European Beet Sugar Crop.

By Our Continental Correspondent

The condition of the beetfields is splendid throughout Europe and a full beet crop is certain now. The sugar content of the roots is, however, greatly inferior to that of other years, but the foliage is so strongly developed and so healthy that a good dry and sunny spell in September may increase the amount of sugar in the beets considerably. We are therefore able to raise our estimates for almost every European country. Only a few of them, where sowings have ultimately proved to be much less than was anticipated, have undergone any reduction. The data concerning Russia have not been considered in the following table. All figures are expressed in metric tons raw value:—

COUNTRY.	METRIC TONS.	COUNTRY.	METRIC TONS
Germany	1,600,000	Spain	162,000
Czecho-Slovakia	650,000	Denmark	110,000
Austria	20,000	Sweden	80,000
Hungary	60,000	Bulgaria	15,000
Poland	270,000	Yugo-Slavia	40,000
Netherlands	275,000	Rumania	70,000
Belgium	300,000	United Kingdom	10,000
France	500,000		
Italy	250,000	Total Europe, except Russia	4,417,000
Switzerland	5,000		

Fifty Years Ago.

From the "Sugar Cane," September, 1872.

In this number there appeared two letters (translated from the *Journal des Fabricants de Sucre*), which were headed "Improvement of the Polariscope," the first being by **Maumené**, and the second by **Campion**, two well known chemists of their day. In the first it was said that **Duboscq**, the French optician, had brought Soleil's "beautiful instrument to a state of great simplicity and precision." This he had done by adopting Cornu's modification of the Jellett polarizer, and the result was that "persons the most unaccustomed to optical observations have seen at the first glance the equality of the two shadows, and they have invariably agreed with my observations. The precision of the new method is greater for many reasons: (1) Because the comparison of two shadows is easier than that of two bright colours . . . . (2) The measurement in the new saccharometer is essentially angular . . . . (3) It is easy to employ highly concentrated liquors and consequently to reduce the proportion of any observational errors . . . . " **Campion** in his letter was equally enthusiastic regarding the new "saccharometer," stating that "the great sensibility of the instrument allows of the use of twice the number of divisions on the scale that are on that of the ordinary polariscope," so that it was possible with the Jellett-Cornu instrument to read to 0·25 per cent. of sugar, a series of observations with the old and new "saccharometers" demonstrating this point.

Part of an article by the distinguished engineer Dr. C. W. **Siemens**, entitled "On a Steam Jet for exhausting Air," was here reproduced; and in it appeared the following statement relating to boiling which is interesting to read at the present time: "On the contrary, a vacuum pan exhausted by the steam-jet exhauster is a very simple apparatus, only requiring a supply of steam at a moderate pressure for the jet which exhausts the vapour given off by the boiling solution or sugar or other liquid in the pan, and the steam and vapour together are then passed through the heating tubes of the pan, thereby producing evaporation. The area of the steam-jet is regulated by a hand wheel. By this arrangement the costly vacuum pumps and the steam engine, or other motive power, are dispensed with, as well as the condenser and its supply of condensing water, the latter being in many places a consideration of vital importance, and in their stead is substituted the steam-jet exhauster—a comparatively cheap and simple apparatus requiring little or no attention, and not liable to get out of order. . . . . "

Beet sugar manufacture at that time was being introduced into America. The Sacramento Beet Sugar Co. had planted 1100 acres, from which they hoped to get 10 tons of roots to the acre, and a total of 10,000 barrels of white sugar, fetching about 8 cents per lb. This anonymous article concluded by stating that "wherever the promotion of rational principles in agricultural pursuits is a desirable object, or where a declining productiveness of the soil calls for efficient assistance, there it will be found of inestimable service to study the ways and means by which the true relation of the various farm crops to the sugar beet have been ascertained, and the beet sugar manufacture rendered a lucrative agricultural and industrial business. . . . . "

There were two patents abstracted in this number. The first[1] related to a new construction of covers for centrifugal machine, enabling steam and air to be admitted instead of water; while the second[2] disclosed a vacuum pan, the bottom and sides of which were jacketted.

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[1] English Patent, 235 of 1872. [2] English Patent, 326 of 1872.

The Report of the Sugar Enquiry Commission, South African Union, 1922.

From a perusal of the interesting article by WUTHRICH[1] on the Sugar Industry of Natal and Zululand in a recent number of this Journal, we gather that all is not well there, and we have accordingly paid some attention to a copy of the Report of the Sugar Enquiry Commission in the Union of South Africa[2] which has come our way. The terms of reference include an investigation into the arrangements existing between planters, millers and refiners, as to production and manufacture: the arrangements by which sugar and its by-products are sold in the Union, whether to manufacturers, for wholesale and retail consumption or for export; and the necessity and nature of protection against outside competition.

The Commission, in dealing with these subjects, has perforce had occasion to review the whole industry, and much light is shed upon the peculiar conditions under which the crop is grown in Natal and Zululand. In Natal the great bulk of the sugar cane is grown by the millers themselves, and, as there are no agreements between millers and planters to consider, comparatively little attention is paid to this part of the sugar growing area; in Zululand, on the contrary, growing the cane and the manufacture of sugar are usually independent and have given rise to complicated agreements with which the larger part of the Report deals. These agreements appear to be in urgent need of revision. The cane industry in Natal dates from the middle of last century. In 1905 some 30,000 tons of sugar were produced; this had grown by 1910 to 80,000; from 1914-18 a little over 100,000 tons were produced, and during the past four years the figure was about 150,000 tons excepting in 1919-20 when it reached 189,000. The first great impetus thus appears to have taken place between 1905 and 1910, and we note that it was during this period that cane planting was taken up in Zululand, and the agreements between planters and millers were drafted. The coastal belt in Zululand was opened up to settlers in 1905 with the primary idea of growing sugar cane for which it seemed to be eminently adapted and, as it became necessary to provide mills to deal with the produce grown by the settlers, tenders were invited. A concession demarcating the region covered by the mills was mapped out and this was granted to Messrs Hulett & Co., who agreed to erect the necessary mills. Agreements were drawn up between the growers and millers and between the Government and both. The millers were required to deal with a certain quantity of cane which was to be grown by the planters within the bounds of the concession, and proper manufacture and cultivation were made obligatory: the canes were to be paid for at the rates agreed upon between the millers and planters and the latter were guaranteed the preference in case others growers subsequently desired to grow and sell their canes: canes could be delivered between May 1st and February 1st of the year following and had to be dealt with by the mills: for transport purposes tram lines had to be laid down through the concession at the expense of the millers and the planters were bound to make use of such transport facilities as were provided under certain terms: the agreements with the Government were for 99 years, and those between millers and planters for 25 years after which a revision was to be made if necessary, and the Government could terminate the agreements in case of default of either of the contracting parties. Messrs. Hulett & Co., took up their concession in 1905, and they erected mills at Amatikulu and Umhlatuzi. In 1911 a second concession was granted to the Zululand Milling Co., with a mill at Empangeni, and in 1913 a third was granted to the St. Lucia Co., with a mill at

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[1] *I.S.J.*, 1922, 243-247.

[2] *Cape Times Ltd.*, Government Printers, 1922

Umfolozi. The agreements in these cases were substantially on the same lines as that in the first concession though with some minor variations. The price paid for cane was at first arranged as follows. When the price of first quality sugar in Durban averaged for any month 17s. per 100 lbs, the price of "fair marketable cane" was to be 12s. per ton of 2000 lbs, in the case of Uba, and 13s. for any other variety grown. This was altered later, when Messrs. Hulett set up their refineries in Durban, first refined sugar taking the place of first quality sugar at 18s. instead of 17s. No provision was made for analysing the canes and they were sold by weight irrespective of sucrose content.

We are not informed as to the period at which these agreements were first seriously found in fault, but presumably such differences as occurred between millers and planters were at first easily adjusted. One such case is mentioned in the matter of burnt cane. One of the outstanding objections to the Uba cane is that its leaves cling so tightly to the stem that they are not shed even after death, and, in places where labour is scarce or unsatisfactory as in Zululand, cleaning the canes for the mills became a serious item of expense. Burning the trash off before cutting has thus become universal in the concessions. On the millers objecting, the matter was referred to arbitration and it was decided that, as burning did not appeciably affect the sucrose content if the canes were promptly dealt with they were not entitled to pay less for canes thus burnt. This decision was unfair to the millers, as is now recognized by the Commission. It was soon discovered that the payment for cane by weight alone was unsatisfactory. From the planters' point of view it has obviously had very serious consequences, in that there was no encouragement for them either to try and improve their soil or the quality of their canes: the good planter was thus penalized by the bad. From the millers' point of view the matter was more serious still, and in one case at any rate, that of the St. Lucia Co., it has been the main cause of a disastrous failure. It has been found that, while the canes grown in Zululand on the hills sustained their sucrose content, those in the lowland or "flats" fell off considerably, although at the same time the tonnage considerably increased. As St. Lucia has an especially large percentage of flats cane to deal with, it is not surprising to learn that in no single year has this mill shown a profit and that its accumulated losses are in the neighbourhood of £150,000. Obviously this cannot go on and, if a change is not made at a very early date, the concern will have to close down, entailing widespread disaster, this time to the planters who will be without an outlet for their canes. These two cases will suffice for the present to show the faults which have gradually come to light with regard to the agreements entered into as between millers and planters.

A long list of grievances has been made out by the planters and a shorter one by the millers. These we need not discuss in detail, but the inevitable result of these faults in the agreements has been that the cultivation side of the industry, never very carefully studied even in Natal, has reached the danger limit in Zululand. Very little cultivation is given either to plant canes or ratoons, the latter are continued for long periods, practically no manure is applied to the soil, diseases are becoming increasingly evident in the fields, and no care has been taken to have a second string to the single variety of cane grown. It may not be out of place here to remark that the Uba which is the variety exclusively grown is, at the best, only a second class cane, and although it has undoubtedly been of the greatest service to the Natal planters in the past, and will probably for a long period be usefully grown in many parts of the Colony, it is becoming increasingly evident that it is not the proper cane for growing in the low land of the Zululand concessions.

It is a somewhat remarkable fact that a sugar industry, whose output is approaching 200,000 tons a year, has not and never has had an experimental station. And in the absence of scientific advice which could be called for from such an institution, we may be permitted to offer a few remarks upon the Uba cane with which we are fairly well acquainted. It is now generally recognized that this cane has been ultimately derived from North India, and belongs to the Pansahi or Maneria group of indigenous Indian canes, which perhaps reaches its greatest development in the neighbourhood of Bihar. It appears probable, according to NOËL DEERR, that it came to Natal, in the first instance, from Mauritius which country received it from Brazil, but how it came to Brazil is at present an unsolved mystery. The opinion held in some quarters that it is a Japanese cane is negatived by the fact that the authorities there disclaim there being any indigenous canes in that country; and we may surmise that, as it is said also to have been long grown in Angola, it was introduced to Brazil by the Portuguese many years ago, whether direct or through some of their African possessions. There is no reason of which we are aware to suppose that it came from Poona as suggested by WUTHRICH: canes of the Pansahi group are not found in that part of India. In its own original country it is one of the *ganna* canes, half way between the thinner, hardier, more fibrous *ukh* canes and the introduced, thick, juicy tropical or *paunda* canes. The members of the Pansahi group are characterized by being half hardy, with abundant juice of a rather poor sucrose content, but with great tillering power and, if healthy, with luxuriant foliage. During the past half century, however, these canes, in some respects ideal for the making of gur or jaggery as contrasted with white sugar, have steadily diminished in favour in North India, because of their liability to disease, and they have been displaced over large tracts by the more hardy but less juicy *ukh* canes referred to above. The disease which they suffered from is not definitely specified, but there appears to be little doubt, from recent researches, that the disease which caused this replacement of the *ganna* canes by *ukh* varieties was none other than the red rot caused by *Colletotrichum falcatum*. This disease is rarely dangerous in perfectly drained soils, but at once makes its appearance where there is a suspicion of waterlogging. Free drainage and light rainfall appear to be a characteristic of the Natal sugar cane zone, especially in hill areas, but from all accounts this is not the case with the stiffer soil of the low lands in Zululand. There appears to be little care in Natal in selection of good, sound seed for planting and this will naturally be more difficult where the canes are planted whole in the furrows without removal of the trash: and if the crops are always burnt before taking to the mill, as is universal in Zululand, the planters will have little knowledge of the progress of this disease in its earlier stages in the fields. That the percentage of sucrose in the cane juice is lower in the flat land than in the hills is not denied, but this is a matter of no concern to the growers, as long as the canes are paid for by weight and no account is taken of the richness of the juice. The millers complain of the Uba that it is very hard to crush and that the excessive amount of fibre and gummy matters in the juice give them trouble in the extraction of the sugar. If a diseased condition of the stalks is added, there is little wonder that the St. Lucia Co's mill at Umfolozi (where "flats" canes reach a proportion of 75 per cent., of the crop) has been fighting a losing battle from the beginning. The obvious remedy is to introduce new cane varieties better suited to the conditions of the low levels of Zululand, together with greater attention to draining and other elementary agricultural needs of the sugar cane in all tracts with heavy, moist soil. We would make the following suggestions as to new varieties which might be tried.

(1) A trial should be made of the Java seedlings (P O J 33, 37, 213, 228) obtained by crossing Cheribon with the Indian *ukh* cane Chunnee. These canes throw their leaves much more readily than the Pansahi group, are rich in sugar and give considerable crops; the matter of ratooning under Zululand conditions would have to be tested, and special care will have to be taken as regards *smut* to which they appear, though in different degrees, liable, while they are known to be carriers of the mosaic disease.

(2) A trial should also be made of some of the new Coimbatore seedlings which have given good results in India, and some of which are now being tried on a crop scale: information as to these should be sought from the Secretary, Sugar Bureau, Pusa, Bihar. They appear to be specially suited to Bihar conditions, a country from which the Uba probably originally came.

(3) Lastly, there are suggestive hints that Zululand will be better able to grow thick tropical canes than Natal and especially in the lower levels. There are various forms which are equally well suited to cooler climates and the tropics themselves, and these should be at any rate given a trial. Among them, and other observers would doubtless be able to increase the list, Red Mauritius and J 247 seem to the writer likely to succeed, while D 1135, D 74, D 95, B 147, B 376 might also have a trial. Information concerning this class of cane could doubtless be furnished by the Sugar Cane Expert at Coimbatore, South India.

From all accounts Uba is not suited to all places in the Natal-Zululand tract and, wherever this is found to be the case, some such canes as those mentioned should undoubtedly be tried. The matter is, however, one that must be studied locally: the question of fuel for instance will probably have to be taken into account, and it is quite possible that this will in certain cases be a limiting factor. In any case, it appears to us that one of the greatest dangers in which the South African sugar industry finds itself at the present moment is the absence of any cane to fall back upon, if the Uba is driven out of cultivation as other members of its class have been in North India.

The ground covered by the Commission in its review of the South African sugar industry is far too wide to be dealt with in a single article and we shall continue to confine ourselves to a consideration of the effects produced by the miller-planter agreements in the Zululand concessions. The many complaints made by the planters against the millers as regards the carrying out of these agreements do not, on the evidence recorded, impress us; and we agree with the Commission's finding that the millers appear to have attempted to carry out their part (often to their great disadvantage, as in the St. Lucia case) in a loyal and common sense manner. What concerns us more is that, while the factories appear to be generally well equipped and managed, the plantation work seems to be of a very inferior kind. Most of the planters we are told keep no books, there is no selection of good seed for planting, no experimental work, little cultivation and practically no manuring: this will hardly appear to most cane growers as a fitting way in which to carry out the planters' agreement to give the canes "proper cultivation." The terms of the agreement, the extraordinary vitality of the Uba cane and the excessively long periods of ratooning appear to be, in the main, the cause for this low level of plantation work.

As the agreements were drafted, any canes presented between May 1st and and February 1st of the following year must be dealt with by the mill, and payment made, according to the price of 1st. refined sugar in Durban, on the weight of canes received. The season during which the mills have to receive canes sent in by the planters (9 months) is far too long for economical working.

We are told that this period was arranged so that all the canes grown by the planters might be dealt with and also that the millers might erect smaller plants. But the net result has naturally been that much immature or overripe cane is brought in (the state of maturity being no concern of the grower), and it would obviously be greatly to the advantage of the industry if the period of milling were shortened. The following returns from the Amatikulu factory illustrate this point: the canes received on May 14th were very unripe, the optimum was reached on September 3rd after which there was a steady decline in sucrose content.

1921	May 14	Sucrose per cent. in cane	9·5.	Tons cane to one of sugar	15·0
,,	May 28	,, ,, ,,	11·8	,, ,, ,,	12·0
,,	June 26	,, ,, ,,	13·7	,, ,, ,,	10·9
,,	July 23	,, ,, ,,	14·0	,, ,, ,,	10·2
,,	Aug. 30	,, ,, ,,	14·5	,, ,, ,,	9·7
,,	Sep. 3	,, ,, ,,	15·0	,, ,, ,,	9·6
,,	Oct. 1	,, ,, ,,	14·3	,, ,, ,,	10·3
,,	Oct. 29	,, ,, ,,	12·8	,, ,, ,,	11·7
,,	Nov. 26	,, ,, ,,	11·9	,, ,, ,,	13·5

As things are, the capacity of the mills appears to be sufficient to deal with all the canes brought in by the concession planters as well as a considerable quantity grown by outsiders. We note that many of the concessions made for cattle rearing are now growing cane. But with all this the mills are reported to be often idle during considerable periods of the allotted milling season. Obviously this is a great loss both to the mills and the industry as a whole, as the best results are not obtained from the canes grown.

A further anomaly is the fact already referred to that the "flats" canes do not ripen properly, the analysis of the Uba juice in these approaching that obtained in the tropics and India. The yields are however heavy and thus the profits made by all mills dealing with low land canes are at once depreciated. The following summary from Umhlatuzi factory, which uses both kinds of cane, for 1921 is instructive.

1921	May	sucrose per cent. in "hill" canes	12·10;	in "flats" canes	9·59
,,	June	,, ,, ,,	12·80	,, ,,	9·92
	July		12·83	,, ,,	11·50
	August		14·24	,, ,,	11·74
	September		14·17	,, ,,	12·02

These are of course average figures and the extremes in sucrose content recorded during this season were much greater, namely, June 15·23 and 6·06, July 15·43 and 6·10, August 15·69 and 8·50, September 16·27 and 8·01; the lower figure in each case presumably being recorded from consignments of unripe flats canes. We have already referred to the probability that the conditions of this part of the concession area are unsuited to the Uba cane, and the figures given above seem to point in the same direction, at any rate as regards its usefulness as a sugar producer. The growth of the Uba cane in the low lands, where there is comparatively little check during the cold, dry part of the year, is however rapid and luxuriant, and the great tonnage obtained is doubtless more satisfactory to the planter, who is paid by weight only, than it is to the miller. There is little doubt that these anomalies have had great influence on the care taken in growing the canes. There is no inducement to the planter to produce good canes or to improve his land, provided that he is able to reap a large quantity of cane.

And in this he is aided by the Uba cane itself, in that, with all its failings, it belongs to a much hardier class than the thick, juicy canes of the tropics. The Indian canes tiller much more freely than the latter, are less tolerant of high cultivation and especially of the heavy manuring usually applied. Following this line of reasoning, we come indeed to the somewhat paradoxical result that the planters have unconsciously been giving this extraordinary cane just as much cultivation as is good for it! But the suspicion also obtrudes itself that it was exactly this low level of agricultural operations which caused the failure of the older, richer canes which were formerly grown in Natal. It would be a pity if it were proved that the cane which is considered to have saved the industry in a former crisis should now be the cause of its downfall in the more stringent conditions of to-day. There is thus a fine field opened up for experiment, without which there can, after all, be merely conjecture. Two facts must however be faced. In the first place, for making white sugar, the Uba cane as at present grown is unsuited to the lower parts of Zululand; and, in the second, owing to the present system of neglect of the conservation of moisture and of soil fertility, the tonnage of canes is steadily going down, both in the hill and flat country.

There can be little doubt that ratooning a crop for a long spell of years is a severe tax on the soil; and with such an exhausting crop as the sugar cane, it is difficult to suggest safeguards, especially when it is the practice to follow one set of ratoons immediately by another. Of course a green manuring crop can be intercalated, if time is allowed for it, but we learn that green manuring is practically unknown. Rotation, which is an obvious remedy, is likewise to say the least unusual, although there is reason to believe that the cotton grown in the tract is likely to be of a high class. A ready excuse for the scant cultivation is the lack of a sufficiency of reliable labour, and this might well prove a limiting factor as far as the picking of the cotton crop is concerned, unless as elsewhere it appeals to the natives of Africa more than the heavy sugar cane work.

The whole position of the plantation side is seen to be full of difficulties, whichever way we turn. Few attempts seem to have been made at the introduction of labour-saving devices, and the position is not minimized by the apparent absence of any effort in the past to solve the various problems connected with the growing of sugar cane in the tract by a series of well organised experiments. The early foundation of one or more experiment stations in Natal and Zululand—and it is pretty certain that with such diverse conditions one will not suffice—urged by the Commission in a short paragraph at the end of its Report, appears to be the only step about which there seems to be no manner of doubt; and some pains have been taken in this article to suggest some of the many problems which should receive attention at the earliest possible moment.

C.A.B.

Some interesting experiments carried out by the National Physical Laboratory last year on the behaviour of tramcars with or without roller bearings showed broadly that the car with roller bearings required in actual service a little under one-third less current than the car with ordinary bearings when running light and over one-fifth less when loaded. These trials which were carried out under service conditions were made on behalf of the Hoffmann Company.

Unusually cordial relations exist between the Chemical Industry Club, Whitehall Place, London, S.W.1, and the Chemists' Club, New York City, and both institutions welcome visiting members of either club. This has not only promoted acquaintance and friendship on the part of chemists of the two nations, but is the means of favourable entree for those interested in plants and laboratories in the two countries. Letters which have been exchanged between the two secretaries convey warm greetings and assure a continuance of the good feelings which should be maintained for many years.

The Sugar Supply of the United Kingdom.

By F. I. SCARD, F.I.C.

Immediately prior to the war, of the sugar imported into the United Kingdom about 66 per cent. came from Austria and Germany, 20 per cent. from other European sources, 10 per cent. from foreign, and 4 per cent. from British cane sugar producers. When the war broke out, the evil of the supply being thus dominated by two enemy countries became immediately apparent, and the danger of dependence on a source of supply which might at any time be cut off was then illustrated in a forcible manner. The utmost quantity of British sugar available at that time for the mother country was not more than 550,000 tons, approximately 27·5 per cent. of the 1,969,000 tons imported during 1913. It consisted of sugar from the British West Indies, which with the exception of the small quantity of "Demerara" and grocery muscovado which came to the mother country went to Canada, which was already giving British sugar preferential tariff treatment; Mauritius white sugar, to about the same extent as the refining West Indian, which was attracted to India; and a few thousand tons of Fiji sugar which was consigned to the Canadian refiners.

In 1919 the present Preferential Tariff came into force in the United Kingdom, which at the present rate of duty gives a preferential value of £4 5s. per ton to British white plantation sugar, and £3 15s. per ton to British 96° sugar. What has been the effect of this upon United Kingdom supplies?

During the first six months of the present year the imports of sugar into this country were made up, roughly, of 48 per cent. of Cuban 96°, 17 per cent. of American granulated made from Cuban sugar, 16 per cent. of British cane sugar, 15 per cent. of cane sugars from other countries, and 4 per cent. of Continental beet sugar. The direct and indirect supply of sugar from Cuba was thus 65 per cent., about the same proportion as obtained before the war in the case of German and Austrian supplies. The increase, such as it was, in the proportion of British sugar was due entirely to the preferential treatment having diverted West Indian sugar from Canada, and Mauritian sugar from India, to the United Kingdom, coupled with some excess sugar from Natal, where the glamour of the 1920 prices has led to production in excess of the South African requirements. With the exception of the latter, the quantity of British sugar available for United Kingdom purposes is practically the same as it was in 1913.

The quantity of sugar consumed by the population of the British Isles has been rising the last few months, as was pointed out in the last issue of this journal, so that the pre-war figure, at least, of about 1,750,000 tons per annum is once more in view. To meet this demand, on the supposition that none of the available British sugar goes to Canada, there are only about 220,000 tons of 96° West Indian sugar, equal to say 200,000 of refined, 30,000 tons of "Demerara" and grocery muscovado sugars from the same source, and a doubtful 75,000 to 100,000 tons of sugar from Fiji and Natal, partly refining and partly white plantation; in all on an outside figure, the equivalent of 550,000 tons of consumption sugar.

As things are at present, there is no sign of a change for the better in the position. Indeed, it is worse. The United Kingdom is now dependent upon a single foreign producing country instead of two for two-thirds of its sugar supply, a supply which a lessened production from drought or other causes, an increased demand in the United States, or some other cause might at any moment jeopardize or cut off entirely.

Another source of danger to the United Kingdom sugar supply is the weakness of its refining industry. The quantity of sugar contributed by the refiner is only from 50 to 60 per cent. of the present consumption, and, although Sir **Robert Park Lyle**, in a recent letter to the *Times*, made the statement that the refiners *could* supply all the sugar wanted for consumption, there is no sign of their ability to do so. The public has, therefore, to be supplied with direct consumption sugar from elsewhere, and as consumption increases, unless the refiners' position in this respect improves, the trouble will become accentuated. No matter how ample the supply of sugar for the refiners may be, the amount of the public supply does not benefit by it beyond their power of output by reason of their want of refining power. As but little direct consumption sugar is made in Cuba, the refining deficiency has to a large extent to be made up, or rather, has been made up, by Cuban sugar viâ the United States refiners.

What is the remedy for this unsatisfactory state of things? There is only one reply to this query, and that is, for the Government to make it worth while to home capitalists to invest in Colonial sugar production. As the enquiries instituted by the West India Committee and the Society of Chemical Industry have brought out, there is ample scope for sugar promotion in British Colonies, such as those of West Africa, still unexploited in this respect, and fitted by soil, climate and population for sugar production; there would also be resulting from such promotion a considerable extension of trade in connexion with repairs, maintenance, stores, etc., of industrial benefit to this country. But the broader view of the case, the one which sees that the sugar supply of the United Kingdom should be in British hands, is the one which should prevail in the interests of the public of the United Kingdom.

The Deterioration of White Sugar during Storage in Mauritius.[1]

By H. A. TEMPANY, D Sc., F.I.C., F.C.S.,
and D. D'EMMEREZ DE CHARMOY.

OCCURRENCES OF DETERIORATION OBSERVED IN MAURITIUS.

While the liability of sugar to deterioration has long been known in Mauritius, the question had attracted comparatively little attention prior to the year 1918. It was well recognized that in these regions of the islands where the rainfall is naturally high, sugar was at times liable to deterioration on prolonged storage; but instances of damage recorded were for the most part not very numerous.

However, in recent years, labour and shipping difficulties together with a shortage of railway materials have caused delays in the removal of the crop; consequently it has been necessary to retain relatively larger quantities of sugar in store on estates and in railway and dock warehouses during the rainy season, viz. January to May, when atmospheric conditions are very favourable to the deterioration of stored sugar. Secondly, the quantity of sugar in hand at the end of the crop has increased, necessitating storage thereof for a longer period of time. Thirdly, of recent years there has been a steady tendency towards increased production, which has not until very recently been accompanied by a corresponding increase in transport facilities.

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[1] Editorial abridgment of Bulletin No. 24, General Series, published by the Department of Agriculture, Mauritius, May, 1922.

CHARACTERISTICS OF DETERIORATION OBSERVED.

The actual phenomena observed in Mauritius in relation to deterioration have been in general similar to those recorded in other places; and the following account is based on observations made by the authors on many thousands of bags at a large number of places in the Colony. "Sweating" of the bags is usually first to call attention to the fact that something is wrong, examination showing that the affected portions are damp and sticky. If deterioration has proceeded sufficiently far, the sugar may be more or less liquefied, and a syrupy liquid may drain away.

It is important to record that the deterioration always begins in the outermost layers of the sugar contained in the bags, and proceeds from the outer layers inwards; no single instance was detected of deterioration commencing otherwise than in the outermost layers. Further in sugar stored in warehouses, the deterioration is for the most part confined, except in extreme cases, to the lowest layer of bags and to that side of the bags in this layer which is undermost and in contact with the floor of the warehouse. In cases when bags are stored on sleepers, or other form of dunnage resting on the floor, the deterioration in the early stages confines itself to those portions of the bags in contact with the sleepers. In some cases, in localities with a very high rainfall, it was found that end bags in lines which flanked on the gangways leading to doors, or opposite to windows which were liable to be opened from time to time, also showed deterioration, which was however confined to the ends or sides of the bags so exposed.

In all the cases examined, the deterioration had never proceeded beyond the lowest layer or the outermost line of bags, and even in the wettest localities the bags in the interior of stocks were in good order. It is of course to be understood that if the conditions leading to deterioration were allowed to continue indefinitely the whole mass would in course of time probably become affected, but the material is universally removed before succeeding bags have been attacked.

COMPOSITION AND CHARACTERISTICS OF MAURITIUS SUGARS.

The bulk of Mauritius sugar is of the plantation white type, locally known as *vesou*, which at present constitutes 95 per cent. of the crop. Characteristically *vesou* is a typical high-grade white sugar and contains 98·5 to 99·2 per cent. sucrose. Its average composition may be stated as follows:—Sucrose 98·5 to 99·2; reducing sugars 0·5 to 0·8; moisture 0·15 to 0·3; ash 0·1 to 0·3 per cent.

It will be seen from the above data that though the average moisture to non-sugar ratio of sugar of this type is well below the factor of safety, nevertheless, owing to the high sucrose content, comparatively small additions of moisture may raise this ratio beyond the danger point.

ORGANISMS RESPONSIBLE UNDER MAURITIUS CONDITIONS.

The samples examined represented material taken from deteriorated bags in store and also from samples kept under controlled conditions in the laboratory which showed evidence of deterioration on keeping, the following tabular statement showing the result of the examination of 45 samples[1] together with, in certain cases, the number of organisms found per square cm. on plating out on 50 per cent. sucrose-agar.

It will be observed that all three types of organisms recorded as responsible for sugar deterioration in other countries are found to be present, viz.: Torulæ, moulds and bacteria. Undoubtedly the Penicillium is *P. glaucum;* and the Aspergillus is *A. glaucus.*

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[1] Only a few of the results given by the authors are here recorded.—ED., *I.S.J.*

It is worthy of note that no very definite correlation appears possible between the number of micro-organisms present and the degree of deterioration observed, the observation not bearing out that of Kopeloff in this connexion.[1]

Tube marks	Result of direct Microscopical Examination.	Torula, Colonies per cm^3.		Fungi and Bacteria, Colonies per plate of 85 cm^2
D. 2 ..	Bacteria in numbers; mycelium and spores scare—no torulæ—brownish Penicillium—sugar very moist ..	80	..	6,800
N. A. ..	Spores and mycelium common. Sugar compact, no torulæ	760	..	2
O. 4 ..	Spores in mumbers; 2 species of Penicillium. Torula pink and whitish Aspergillus. Sugar compact and syrupy.			
M. 2 ..	Torulæ in numbers, Mycelium scarce. Bacteria in groups, common. Fungus without fructifications—Mycelium giving chlamydospores — Sugar melted and containing ants.	95	..	53
L. 1 ..	Torulæ predominating, few bacteria, mycelium scarce. Sugar melted and containing ants.			
M. 1 ..	Torulæ in great numbers, no bacteria no mycelium, sugar not syrupy, but agglomerated into a compact mass.			
O. 3 ..	Compact and rather syrupy—mycelium			
N. 1 ..	No torulæ. 2 species of Penicillium brown and greyish Top of sugar moist but still granular, bottom compact.	505	..	6
E. 1 ..	Nothing. Top slightly moist, bottom compact.			
H. 1 .. X ..	Spores and mycelium. Penicillium brownish. Sugar in same state as above	1,400	..	10
N. 2 ..	Torulæ common. Mycelium and spores in great numbers. Top of the sugar compact and rather syrupy.			
G. 5 ..	Top moist and bottom compact. Mycelium very scarce, bacteria in top, spores common.			
F. 5 ..	Spores in numbers. Brownish Penicillium and greyish. Sugar uniformly compact	975	..	0

It should also be remembered that examination of undeteriorated samples of sugar has not revealed the presence of any large number of micro-organisms as a general rule.

Of the organisms recorded, the authors incline to the opinion that Torulæ are probably the most important destructive agents under Mauritius conditions. The particular organism encountered appears to differ to some extent from those described by Browne[2], and the following description of it is subjoined as being of interest:—

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[1] *I.S.J.*, 1920, 282, 523. Subsequent to the performance of the work recorded in this paper, the attention of the writers was directed to a paper by W. J. Th. Amons (*I.S.J.*, 1921, 470), in which the author, after enumerating a large number of moulds found in deteriorated Java sugars, comes to the conclusion that there is no relationship between the number of micro-organisms and the degree of deterioration.

[2] *I.S.J.*, 1918, 226, 265, 319.

On agar, containing 50 per cent. of sugar, the colonies are only visible with a lens forty-eight hours after inoculation. These colonies are sometimes of the same size, and sometimes of two different dimensions. Those included within the agar are hardly visible to the naked eye, while those growing on the surface reach a diameter of 0·3 to 0·5 mm. They are at first transparent, but later on become almost opaque. Under a low power of the microscope, the colonies are clearly rounded and somewhat granular in appearance. When examined with direct light they are white and absolutely opaque.

Under a high power the Torula is seen to affect two forms, a giant and rounded one, the small form being about half the size of the large. The small cells are always found in much greater numbers, and are less regular in shape, being somewhat ovoid or acuminated at one end. It varies in diameter from 2·6 μ to 7 μ with an average diameter of 4·5 μ to 5 μ. The granulations are numerous and exhibit very rapid vibrative motion. Budding is rather scarce although apparent signs of some are conspicuous. There are never formed strings of any appreciable length. In sugar solutions, with or without the addition of nutrient media, whether grown in pure culture or not, the cells are much smaller than on agar, more transparent and show scarcely any vacuoles.

When stained with Grübler's medicinal pure methylene blue, the plasma takes a pale blue colour and the metachromatic corpuscles stain pink, or darker if the time of staining is prolonged. In 10 per cent. sugar solutions the growth of the Torula is less rapid than it is in 50 per cent. solutions. Turbidity is not noticeable before 48 hours, after which the ferment begins to settle, the liquid becoming clear again after a few days. A fair amount of sediment is obtained. Effervescence is never produced, only a few bubbles of gas escape during fermentation, and this never before 48 hours after inoculation. On sweet potato, the organism grows readily and forms a rather thick white shiny layer which spreads over nearly the entire surface of inoculation, without however covering the other sides of the slant.

CHEMICAL CHARACTERISTICS OF DETERIORATED SUGAR.

It was noticed that the total content of sugars in samples undergoing deterioration shows on the whole a progressive diminution corresponding to the destruction of sucrose, indicating that simultaneously with the inversion of the sucrose, destruction of the reducing sugars formed is taking place. It was also noteworthy that in many cases the direct polarization showed a higher value than the sucrose as determined by the Clerget process, pointing to selective destruction of the levulose formed as the result of the process of inversion.

The actual process of deterioration as it occurs in bagged sugar was studied by means of investigations on a typical bag of sugar in which deterioration had commenced. The bag was taken from the lowest line of a stack which had been in store for some months. The sides of the bags which had been in contact with the floor of the store room were badly sweated. The bag was cut open and the sugar examined. That in contact with the sweated sides of the bag was moist and sticky, the remainder being dry and normal. The following table shows the composition of sugar from the different parts of the bag:—

Portion of bag from which sample was drawn.	Characteristics of Sample.	Moisture per cent.	Sucrose per cent. (Clerget)	Reducing Sugars per cent.	Moisture to Non-Sugar ratio
Upper side of bag....	Normal and dry	0·25	98·1	0·71	1·3
Middle of bag	Normal and dry	0·32	98·6	0·66	2·2
Lower side of bag....	Wet and deteriorated	2·08	93·7	4·09	0·33

Subsequently the dry sugar from the bag was placed in a new gunny bag which was stored in a small galvanized iron shed with a concrete floor during the months of January and February, the two wettest months of the year. At the end of that time, the bag was sweating all round and thick syrup had exuded therefrom and spread all over the floor. On opening the bag it was found that the outer layers had deteriorated badly while the interior of the bag was still sound. Analytical figures as given below were obtained:—

DESCRIPTION OF SAMPLE.	SUCROSE (DIRECT POLARIZATION).	REDUCING SUGARS PER CENT.	MOISTURE PER CENT.
(a) Undeteriorated sugar from the centre of the bag	98·7	0·65	0·29
(b) Sugar from the bottom and sides of the bag	93·0	3·75	2·12
(c) Sugar before storage	98·6	0·66	0·32

Examination of the sugar from the particular bag showed that the preponderant organism was Torula.

These analytical results show quite clearly the effect of moist atmospheric conditions in influencing the rate of deterioration. The shed in which the experiment was conducted was in connexion with the external air by means of a dead space of one inch between the top of the walls and the roof, which was overhung, while the small size of the shed allow it to follow with relatively small lag the changes in atmospheric temperature. Consequently, as the experiment was carried out during the rainy season, the atmospheric humidity especially during the night must have closely approached saturation.

A sample of white granulated sugar was divided into three equal parts and placed in closely stoppered jars, which were sterilized intermittently at 80°C. One was then inoculated with 5 grms. of deteriorated sugar; the second was similarly inoculated, but with the addition of 2 c.c. of sterile distilled water (the object being to raise the moisture content to above the factor of safety); the third was left untouched. All the jars were kept closely stoppered in the laboratory for 45 days and at the end of that time the contents were analysed with the following results:—

	Sucrose (Clerget) per cent.	Reducing Sugars as invert per cent.
1. Inoculated with 5 grms. deteriorated sugar 2 c.c. sterile water	94·7	2·63
2. Inoculated with 5 grms. deteriorated sugar added no water	98·1	0·94
3. Untouched	98·1	0·85

These results show strikingly the necessity for excess of moisture being present to allow deterioration. Incidentally, they also indicate that for progressive deterioration the continuous absorption of moisture is requisite. If deterioration takes place under conditions in which the continuous addition of moisture is inhibited, a point will be reached in which the solution formed will become sufficiently concentrated to prevent further action, inasmuch as the deterioration observed in the watered sample is less than experience would lead one to expect to occur during the time in question. This point has also been directed attention to by BROWNE.

In this connexion it is to be observed that white sugar has an appreciably greater hygroscopic power than lower grade sugars. 21·66 grs. of sugar were exposed to a saturated atmosphere for 10 days in a Petri dish which was withdrawn daily and its weight determined. At the end of that time the sugar had gained 0·56 grs. owing to moisture absorption that is to say 2·6 per cent. of its weight. It will thus be seen that in a comparatively short space of time very appreciable quantities of moisture have been absorbed.[1]

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[1] In our next issue the remainder of this valuable contribution, describing some measures that have been shown to be effective in preventing deterioration, will be given.—Ed., *I.S.J.*

The Sugar Industry in Soviet Russia.

(From a Correspondent.)

The sugar industry in Soviet Russia is rapidly coming to a complete standstill. The normal pre-war production of sugar has been reduced 36 times. During the season of 1914-1915, the production amounted to 1,740,000 tons. In 1920-1921 only 90,850 tons were produced, and in the last season of 1921-1922, 48,000 tons or 27 per cent. of the production for the year 1914. (*Economicheskaia Zhizn*, July 25, 1922). The sowing area of beetroot was not reduced so drastically. But the reduction of the amount of sugar produced as compared to the sowing area is due to the extremely poor harvests. In 1914 1,880,000 acres were under beetroot, and last year only 486,000 acres were immune from insect blight. This year the sowing area was not even equal to the last quoted figure, as only 460,000 acres were sown. (*Economicheskaia Zhizn*, July 4th). At present none can tell how much of the seed will be productive, but judging by the previous years of Soviet farming, no less than ten per cent. will be wasted. The most optimistic forecast, therefore, is that only 420,000 acres will yield a crop and the latter cannot be more than 100,000 tons of beet, taking into account the present very low average of the harvest.

The gathering of the beet harvest is now organized in such a manner that not more than 50 per cent. reach the factories. The peasants who are at present in actual possession of the sugar plantations very reluctantly hand the crop over to the Soviet institutions in charge of the nationalized sugar factories. The reason for this reluctance is, of course, that the Soviet institutions offer very low prices. In this case not only are the prices exceedingly small, but the Soviet offers to take the crop on credit, against the promise to pay in sugar. The peasants have no faith in the solvency of the Soviet institutions and in spite of severe restrictions, are doing their best to sell the beets to private persons were it only as fodder. It may be confidently asserted that this year the Soviet factories will not receive more than 2 to 3 per cent. of the amount that was delivered in normal times. It is worthy of note that in order to work up those quantities of beet the Soviet institutions have designated five times as many factories as would have been necessary in pre-war days. The collapse of transport prevents the crop from being moved along the railways, and factories have to be established in the immediate neighbourhood of almost every big plantation. Such a condition naturally causes a very high increase in the cost of production. Important changes in the organization of the sugar industry have been made this year and they threaten the industry with extinction.

For 1922 the entire nationalized sugar industry is concentrated in the "general sugar committee" subordinate to the high economic organs of the Soviet Government. That institution was solely concerned with the production of sugar, was never questioned upon and never took any interest in the commercial side of the matter. The General Sugar Committee received unlimited credit and no one took the trouble to calculate whether the sugar industry was a paying concern. Naturally owing to the Soviet methods the industry soon began to run at a loss. When the so-called new economic policy was introduced, it was decided that the sugar industry like many others should be placed upon a commercial footing, in other words should be made to be self-supporting. The General Sugar Committee was abolished and a State Sugar Trust was formed. This Trust is merely a bureaucratic Soviet institution with a board appointed by the Soviet Government and with the customary routine of the Soviet institutions. It differs from the

Committee only in that it has no unlimited credit. It only received from the Soviet Government the refineries and certain credits, and it must needs make both ends meet. Unlike the Committee which delivered all the produce of the factories to the Commissariat for Food, the Trust is allowed to dispose of some of the produce on the market.

In the present economic condition of Russia, when there is no free exchange and no freedom of enterprise, the Soviet industry cannot be self-supporting. As soon as the corresponding Soviet concerns try to devise the prices at which goods can be sold without a loss, it becomes apparent that these prices are too high for the population. In spite therefore of the insignificance of the quantities of goods produced, there is always the danger of over-production.

In the sugar industry the high price is also due to very heavy excise duty imposed by the Soviet Government, about five times as high as the pre-war excise duty (*Economicheskaia Zhizn*, July 25th); yet the Soviet Government, being a Socialist Government, has always preached that indirect taxation was inadmissible.

The cost of production and the excise on sugar are so high that in spite of the ridiculously low exchange, foreign sugar in Russia is cheaper than the home produce. The *Economicheskaia Zhizn* of July 18th stated that the cost of production of one pood (36 English lbs.) amounts to 15,000,000 roubles; the excise duty on one pood is 10 million roubles. Thus the cost price of one pood of sugar is 25,000,000 roubles. In spite of very high import duties the price of one pood of foreign sugar in Russia is 24,000 roubles. So the State Sugar Trust is experiencing great difficulty not only in regard to production, but to trade as well.

In conclusion mention should be made of the possibility of importing sugar into Russia. The seemingly favourable prices above referred to should not tempt foreign importers. The market for foreign sugar in Russia is at present very small. The prices are too high for the masses of the population, and sugar is a luxury. Also owing to the complete disruption of the railways, no considerable quantity of sugar of foreign origin can reach Russia outside the few ports open for commerce.

Customs and Excise Statistics relating to Sugar in the United Kingdom for the year ended March 31st, 1921.

The Twelfth Report of the Commissioners of His Majesty's Customs and Excise for the United Kingdom gives the following particulars of the imports and exports of sugar over a period of years running back to pre-war days.

For the year in review (1920-21) the receipts under all heads were £30,445,000, against an estimate of £32,200,000, and receipts of £42,045,000 in the previous year. The cause of the decrease was a shortage in world-supplies to an even greater extent than had been anticipated, which caused prices to rise to a higher level than at any time during the war, and made it necessary for the Sugar Commission, which continued to act until nearly the end of the year, to restrict the domestic ration as well as the allowances to manufacturers.

The total quantity of sugar, apart from molasses, glucose, etc., retained for consumption in the year was 1,093,000 tons, against 1,500,000 tons in the previous year, but actual consumption was probably somewhat higher, as there were reduced clearances towards the end of the financial year. The consumption of glucose, molasses, saccharin and imported sugar goods also fell.

Table I.—SUGAR: CONSUMPTION AND RECEIPTS.

Year ended 31st March.	CUSTOMS. Entered for Consumption, less Over-entries and Duty-paid Exports. Unrefined. Beet.	Unrefined. Cane and other sorts.	Unrefined. Total.	Refined. Imported.	Refined. Refined in Bond.	Refined. Total.	Total Refined and Unrefined.	*Drawbacks (including Sugar in Composite Articles Exported).*	*Due to Isle of Man*(a)	Retained for Consumption (Net).	Imported Composite Articles containing Sugar (Net).	Total Imported Sugar (Net).	EXCISE. Home-Grown Sugar (Net).	Total.
Quantities	Cwt.	Cwt.	Cwt.	Cwt.	Cwt.	Cwt.	Cwt.	Cwt. (*b*)	Cwt.	Cwt.	Cwt. (*c*)	Cwt.	Cwt.	Cwt.
1912	14,392	2,727,446	2,741,838	16,925,879	13,227,371	30,153,250	32,895,088	*777,993*	—	32,117,095	735,823	32,852,918	—	32,852,918
1913	48,031	2,374,342	2,422,373	16,242,486	14,318,738	30,561,224	32,983,597	*920,772*	—	32,062,825	742,798	32,805,623	—	32,805,623
1914	131,070	2,366,953	2,498,023	18,466,825	14,251,672	32,718,497	35,216,520	*936,045*	—	34,280,475	794,822	35,075,297	—	35,075,297
1915	84,447	4,246,006	4,330,453	14,385,978	15,616,754	30,002,732	34,333,185	*773,274*	—	33,559,911	739,735	34,299,646	—	34,299,646
1916(*d*)	64	5,028,031	5,028,095	11,318,851	14,951,929	26,270,780	31,298,875	*1,058,946*	—	30,239,929	808,488	31,048,417	38,427	31,086,844
1917(*e*)	199	5,328,037	5,328,236	6,492,279	14,369,883	20,862,162	26,190,398	*1,045,245*	—	25,145,153	617,352	25,762,505	30	25,762,535
1918	3	4,133,391(*h*)	4,133,394(*h*)	2,773,607(*h*)	14,346,567	17,120,174(*h*)	21,253,568 (*h*)	*505,843*	—	20,747,725 (*h*)	620,972	21,368,697 (*h*)	200	21,368,897 (*h*)
1919(*f*)	16	3,681,627	3,681,643	1,433,660(*h*)	15,312,487	16,746,147(*h*)	20,427,790 (*h*)	*1,127,639*	—	19,300,151 (*h*)	788,531	20,088,682 (*h*)	—	20,088,682 (*h*)
1920(*g*)	2	6,634,797(*h*)	6,634,799(*h*)	8,279,058(*h*)	15,976,725	24,255,783(*h*)	30,890,582 (*h*)	*899,163*	—	29,991,419 (*h*)	1,604,125	31,595,544 (*h*)	—	31,595,544 (*h*)
1921	13	2,261,080	2,261,093	2,290,792	17,618,955	19,909,787	22,170,880	*347,021*	—	21,823,859	1,028,395	22,852,254	37,942	22,890,196
Duty—	£	£	£	£	£	£	£		£	£	£	£	£	£
1912	1,210	185,231	186,441	1,551,401	1,169,193	2,720,594	2,907,035	*71,058*	*4,522*	2,831,455	67,451	2,898,906	—	2,898,906
1913	2,326	156,235	158,561	1,488,567	1,265,498	2,754,065	2,912,626	*84,273*	*4,485*	2,823,868	68,090	2,891,958	—	2,891,958
1914	9,612	159,403	169,015	1,692,716	1,256,159	2,948,875	3,117,890	*85,991*	*4,488*	3,027,411	72,858	3,100,269	—	3,100,269
1915	6,808	328,684	335,492	1,318,422	1,385,000	2,703,422	3,038,914	*71,111*	*5,213*	2,962,590	67,809	3,030,399	—	3,030,399
1916(*d*)	21	958,641	958,662	3,381,634	3,952,035	7,333,669	8,292,331	*182,100*	*12,429*	8,097,802	233,671	8,331,473	13,449	8,344,922
1917(*e*)	16	3,050,007	3,050,023	4,539,126	9,530,498	14,069,624	17,119,647	*591,766*	—	16,527,881	431,604	16,959,485	18	16,959,503
1918	2	2,289,420	2,298,422	1,709,747	9,568,959	11,278,706	13,568,128	*349,292*	—	13,218,836	434,607	13,653,443	63	13,653,506
1919(*f*)	9	4,286,303(*i*)	4,286,312	1,852,125(*i*)	18,260,932	20,113,057(*i*)	24,399,369 (*i*)	*935,534*	—	23,463,835 (*i*)	994,785	24,458,620 (*i*)	—	24,458,620 (*i*)
1920(*g*)	2	7,007,677	7,007,679	10,577,774(*j*)	19,492,866	30,070,640(*j*)	37,078,319 (*j*)	*936,220*	—	36,142,099 (*j*)	2,032,716	38,174,815 (*j*)	—	38,174,815 (*j*)
1921	12	2,411,315(*k*)	2,411,327(*k*)	3,076,502(*l*)	21,397,185	24,473,687(*l*)	26,885,014(*k*)(*l*)	*422,040*	—	26,462,974(*k*)(*l*)	1,308,717	27,771,691(*k*)(*l*)	36,888	27,808,579(*k*)(*l*)

(*a*) Difference between amounts collected in, and allocated to, the Isle of Man. (*b*) Equivalent in Refined Sugar of drawback paid.

(*c*) Equivalent in Refined Sugar of duty paid. (*d*) Duty on Imported Sugar polarizing over 98 degrees increased from 1s. 10d. to 9s. 4d. the cwt., with corresponding increases on other Sugar, Composite Sugar articles, and drawback rates, and duty on Home-grown Sugar imposed, as from 22nd September, 1915.

(*e*) Duty on Imported Sugar polarizing over 98 degrees increased from 9s. 4d. to 14s. the cwt., with corresponding increases on other Sugar, Composite Sugar articles, drawback rates, and Home-grown Sugar, as from 5th April, 1916.

(*f*) Duty on Imported Sugar polarizing over 98 degrees increased from 14s. to 25s. 8d. the cwt., with corresponding increases on other Sugar, Composite Sugar articles, drawback rates, and Home-grown Sugar, as from 23rd April, 1918.

(*g*) Duty on Imported Sugar and Composite Sugar articles of Empire origin and consignment, and duty on Home-grown Sugar, reduced by one-sixth, as from 1st September, 1919. (*h*) Includes 252,733 cwt. of Imported Refined Sugar, and 201,220 cwt. of Unrefined Cane Sugar in 1917–18, 108,760 cwt. of Imported Refined Sugar in 1918–19, and 115,676 cwt. of Imported Refined Sugar, and 368,830 cwt. of Unrefined Cane Sugar in 1919–20, entered to Government account, on which duty was not paid within the financial year. (*i*) Includes duty on 252,733 cwt. of Imported Refined Sugar, and 201,220 cwt. of Unrefined Cane Sugar, entered to Government account in 1917–18. (*j*) Includes duty on 108,760 cwt of Imported Refined Sugar, entered to Government account in 1918-19.

(*k*) Includes duty on 368,830 cwt. of Imported Unrefined Cane Sugar entered to Government account in 1919–20.

(*l*) Includes duty on 115,676 cwt. of Imported Refined Sugar entered to Government account in 1919–20.

Customs and Excise Statistics relating to Sugar in United Kingdom.

Table II.

IMPORTED SUGAR: DETAILS FOR YEAR ENDED 31ST MARCH, 1921.

Refined.	Quantities entered for consumption less over-entries and duty-paid exports.		Duty.	
	Lumps and Loaves.	Other Sorts and Candy.	Lumps and Loaves.	Other Sorts and Candy.
Refined, Imported—	Cwt.	Cwt.	£	£
Exceeding 98°	9,274	2,244,939	11,901	3,026,871 (a)
Other degrees	411	36,168	453	37,277
	9,685	2,281,107	12,354	3,064,148 (a)
Total, Imported Refined	2,290,792		3,076,502 (a)	
Refined in Bond from Imported Material—	Cwt.		£	
Exceeding 98°	15,453,518		19,248,816	
Other degress	2,165,477		2,148,369	
Total, Refined in Bond	17,618,995		21,397,185	
Total, Refined	19,909,787		24,473,687	

Unrefined.	Beetroot. Cwt.	Cane and other Sorts. Cwt.	Beetroot. £	Cane and other Sorts. £
Not exceeding 76°	—	301,350	—	160,556
Exceeding 76°, not exceeding 77°	—	37,116	—	21,617
,, 77° ,, 78°	—	46,004	—	27,777
,, 78° ,, 79°	—	42,057	—	27,787
,, 79° ,, 80°	—	13,856	—	7,018
,, 80° ,, 81°	—	31,469	—	21,481
,, 81° ,, 82°	—	28,044	—	19,849
,, 82° ,, 83°	—	10,777	—	7,031
,, 83° ,, 84°	—	2,915	—	692
,, 84° ,, 85°	—	34,107	—	25,999
,, 85° ,, 86°	—	8,376	—	5,701
,, 86° ,, 87°	9	65,437	8	50,321
,, 87° ,, 88°	—	52,680	—	41,713
,, 88° ,, 89°	—	38,363	—	31,828
,, 89° ,, 90°	—	24,160	—	19,564
,, 90° ,, 91°	—	18,206	—	14,504
,, 91° ,, 92°	—	37,620	—	32,085
,, 92° ,, 93°	—	51,319	—	44,243
,, 93° ,, 94°	—	67,941	—	60,995
,, 94° ,, 95°	4	129,888	4	118,372
,, 95° ,, 86°	—	155,806	—	147,499
,, 96° ,, 97°	—	304,534	—	295,775
,, 97° ,, 98°	—	151,720	—	151,439
,, 98°	—	607,335	—	1,077,469 (b)
	13	2,261,080	12	2,411,315 (b)
Total, Unrefined	2,261,093		2,411,327 (b)	
Total, Refined and Unrefined	22,170,880		26,885,014	
Drawbacks (c)	347,021 (d)		422,040	
Quantity retained for Consumption and Net Receipts	21,823,859		26,462,974	

Table III.

SUGAR: IMPORTS AND EXPORTS.

Calendar Year.		Quantities Imported.	Quantities Re-exported.	Net Quantities Imported.	Quantities of British Refined Sugar Exported.
1911	Refined	18,744,524	23,789	18,720,735	571,524
	Unrefined	19,221,680	140,733	19,080,947	—
	Total	37,966,204	164,522	37,801,682	571,524
1912	Refined	16,216,849	35,555	16,181,294	594,763
	Unrefined	18,134,683	228,153	17,906,530	—
	Total	34,351,532	263,708	34,087,824	594,763
1913	Refined	18,450,897	16,460	18,434,437	465,416
	Unrefined	20,934,293	76,529	20,857,764	—
	Total	39,385,190	92,989	39,292,201	465,416
1914	Refined	17,877,806	18,670	17,859,136	299,936
	Unrefined	21,983,003	159,657	21,823,346	—
	Total	39,860,809	178,327	39,682,482	299,936
1915	Refined	10,109,633	15,330	10,094,303	98,719
	Unrefined	19,537,500	26,547	19,510,953	—
	Total	29,647,133	41,877	29,605,256	98,719
1916	Refined	8,207,783	18,673	8,189,110	89,507
	Unrefined	22,459,388	65,310	22,394,078	—
	Total	30,667,171	83,983	30,583,188	89,507
1917	Refined	3,389,407	2,082	3,387,325	21,806
	Unrefined	24,360,787	12,248	24,348,539	—
	Total	27,750,194	14,330	27,735,864	21,806
1918	Refined	431,027	19,861	411,166	16,088
	Unrefined	25,681,982	4,168	25,677,814	—
	Total	26,113,009	24,029	26,088,980	16,088
1919	Refined	9,242,673	77,999	9,164,674	25,174
	Unrefined	22,846,454	679,718	22,166,736	—
	Total	32,089,127	757,717	31,331,410	25,174
1920	Refined	2,396,238	128,748	2,267,490	44,955
	Unrefined	25,030,878	198,587	24,832,291	—
	Total	27,427,116	327,335	27,099,781	44,955

Table II

(*a*) Includes duty on 115,676 cwt. entered to Government account in 1919-20.

(*b*) Includes duty on 368,830 cwt. entered to Government account in 1919-20.

(*c*) Including the drawback on Sugar contained in composite articles exported.

(*d*) Equivalent, in Refined Sugar, of drawback paid.

Customs and Excise Statistics relating to Sugar in United Kingdom.

The quantities of sugar in any form retained for home consumption in the last ten financial years are shown in Table I, but before the Sugar Commission was established in 1914 there were frequent forestalments or postponements of clearances at the time of the Budget, so that the quantities retained in calendar years are a safer guide to actual consumption in the years to 1914 inclusive. During the war, while distribution was controlled by the Sugar Commission, the quantities retained for consumption, both in the calendar and in the financial years, represent the quantities actually consumed.

Duty was paid on about 1850 tons of home-grown sugar during the year.

Recent Work on Decolorizing Carbons.

Their Testing, Manufacture, Technical Application, etc.

ANALYSES OF DECOLORIZING CARBONS.

P. SMIT[1] has given analyses of three decolorizing carbons, designated as I, II, and III (and not by name), and at the same time also figures for two new animal charcoals, which probably fairly represent the material in Continental use.

	DECOLORIZING CARBONS.			ANIMAL CHARCOALS.	
	I.	II.	III	I.	II.
Water	17·4	15 1	5 6	5·3	5·1
Ash	7·2	1·8	1·7	80·3	81·2
Sulphuric acid	trace	0·2	0·1	trace	trace
Volatile matter	0·3	—	0·1	1·6	1·3
Carbon	75·1	83·0	92·6	9·9	9·4
Sand	0·1	—	—	0·2	0·2
Calcium carbonate	—	—	—	5·8	5·3
Carbonic acid	0·2	0·1	0 1		

TESTING DECOLORIZING CARBONS.

It is now realized that a more accurate method for the evaluation of carbons is required than that generally used. C. E. COATES[2] points out that in sugar work these preparations are probably of value in accordance with the amount of colour they leave in the solution, rather than in that which they may remove. From the colorimetric reading, figures are found expressing the colour removed. On this basis a carbon which would take out 45 per cent. would be half as good as one removing 90 per cent., a statement which is technically incorrect. Similarly, a carbon which would remove 90 per cent. of colour would be carried almost as good as one eliminating 95 per cent., which statement is also inexact. On the other hand, it is not quite correct to call one which leaves 5 per cent. of colour behind twice as good as one leaving 10 per cent. None the less, in the opinion of the writer the second is the less inaccurate of the two and is therefore adopted by him. Here it may be mentioned that P. SMIT[3] holds the view that in order to determine how many times one carbon is more active than another, the amount of each just necessary to effect complete decolorization should be ascertained.

COATES read the solutions before and after decolorizing in Stammer and Duboscq colorimeters, and the comparison was made directly between the lengths of columns having the same tint, no allowance being made for the fact that mathematically colour removal is not quite proportional to the length of column. The solutions were also read with a Hess-Ives tint photometer.

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[1] *La. Planter*, 1921, **67**, No. 5, 77.

[2] *Journal of Industrial and Engineering Chemistry*. 1922, **14**, No. 4, 295-298.

[3] *La. Planter*, 1921, **67**, No. 5, 77.

A good grade of decolorizing carbon was taken as standard, its power being called 100. By comparing the filtrates obtained under specific conditions from the standard char and the experimental char, a more accurate comparison could be made between the dark initial liquor and its decolorized product. As the test liquid, a 3 per cent. solution of cane molasses, which had been boiled and filtered with kieselguhr, was adopted, 6 grms. of the carbon being added to 200 c.c. of this solution in a 500 c.c. flask, the liquid brought to the boil, the flask stoppered, heated in a boiling water-bath for 10 mins. with occasional agitation, and the liquid finally cooled and filtered. As it is necessary to maintain a certain fixed acidity, it would seem that decolorizing experiments in which no mention is made the acidity of the solutions used are of doubtful value. In these tests the writer preferred to keep his solutions at a constant acidity of 0·007 N.

Comparative Results with Well-known Carbons.

E. Saillard[1] has carried out a good number of experiments under varying conditions with several carbons, namely: "Darco," "Norit," and "Carboraffin": and the following is a brief account of the results which he has obtained to date in this direction.

To 50 c.c. portions of a 20 per cent. solution of beet molasses, 0 5 grm. of the three carbons, and also 0·5 grm. of finely ground animal charcoal, was added. In one of the series of tests, the solutions were not heated, while in another they were placed in a water-bath at 78-80°C. during 20 mins. Calling the colour of the untreated molasses solution 100, the colour remaining in the four treated solutions was as follows: animal charcoal, 73; "Darco," 56; "Carboraffin," 25; and "Norit," 57. There was practically no difference at all between hot and cold treatment. It was concluded from these results that "Carboraffin" showed a decolorizing power about three times higher than the fine animal charcoal, and about twice greater than either of the other two vegetable carbons.

Among other conclusions from the experiments carried out by this French investigator were the following:—The duration of contact (30 to 60 mins.) did not affect the result; the decolorizing power was approximately proportional to the amount of carbon used, in the case of comparatively small amounts; given a certain decolorization, a different one was obtained if the amount of carbon is halved and the time doubled; when working under pressure at 110°C., a greater decolorization was obtained than with the same amount of the same carbon in the cold; bubbling in air for the purpose of effecting mixing did not affect the results; the state of division of the carbon was found to exercise a great influence on its decolorizing power, the finer the material, the greater being its action under the conditions of these tests.

Adsorption of Salts and other Constituents.

One of the defects of decolorizing carbons is stated to be its inferior power of adsorbing calcium and other salts from solution, as compared with animal charcoal. As the result of certain other of his experiments, Saillard[2] arrived at the following conclusions: animal charcoal adsorbed about twice the amount of calcium salts taken up by "Carboraffin," and three times that retained by "Darco"; neither animal charcoal, nor any of the carbons examined, adsorbed any potassium chloride from solution; "Carboraffin" took up more free alkali than "Darco," and this latter more than animal charcoal.

Skola[3] determined the amount and nature of the impurities which were taken up by "Carboraffin" during its use in a Czecho-Slovakian refinery, and then ascertained the quantity washed out during sweetening-off. Among the impurities taken up, the calcium was by far the greatest, the iron and alumina, magnesia and alkalis adsorbed being comparatively small. After washing with water, only 6·4 per cent. of the total mineral matter taken up was removed, and among this was relatively little lime. In fact, the calcium was very tenaciously retained, nearly 97 per cent. remaining, while the alkalis were quite easily removed. It was noteworthy that some zinc passed into the wash liquors.[1]

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[1] *Suppl. Circ. Syndic. Sucre de France*, Nos. 1724, 1726, 1728, 1730, and 1734.

[2] *Suppl. Circ. Syndic Sucre de France*, No. 1734.

[3] *Zeitsch. Zuckerind. Czecho-Slov. Republik*, 1922, 46 (iii), 165-171.

ESSENTIAL QUALITIES OF A GOOD CARBON.

W. H. **DUNSTONE**, Jr.,[2] has recorded his observations on the essential qualities of a good decolorizing carbon, based on his experience at Sterling, La. He says that it must be an excellent filtering material. A degree of fineness of grain is important in supplying the maximum surface for colour adsorption, but this must be modified by the porosity of the grain and the organic impurity adsorbing quality of the carbon. Some carbons made very fine for the purpose of providing a high decolorizing power become "slimed up" so rapidly by the accumulation of gums and pectins that a thin impermeable cake only is formed, and filtration becomes either stopped entirely or becomes too slow to be practicable.

Different carbons have different selective colour adsorptions, and this may be important from the standpoint of the appearance of the sugar made, i.e., whether a wholesome sparkling white, or a dull greyish cast. A hard physical structure is essential to withstand the wear and tear in use and in re-burning otherwise the material will break up into a fine impalpable powder, having an inferior filtering capacity. Summing up, this writer says that in choosing a vegetable carbon the following factors should be considered: its decolorizing efficiency; filtering capacity; size and porosity of grain; colour selective property; facility with which it can be sweetened-off; content in soluble salts; hardness of structure; specific gravity; and uniformity of quality. Certain of these factors are, of course, correlated.

THEORY OF DECOLORIZATION BY CARBONS.

Nearly 20 years ago, T. L. **PATTERSON**[3] isolated from animal charcoal an organic nitrogenous material of a gelatinous nature, and claimed that this substance was mainly responsible for the decolorizing power of bone char, being 16 to 40 times more active than the latter preparation. His work was recently confirmed by **HALL**.[4] H. G. **TANNER**[5] now points out that decolorizing carbons which have many times the efficiency of bone char do not contain this alleged essential nitrogenous constituent, and he offers another explanation of Patterson's results. **PATTERSON** extracted the nitrogenous compound with sulphuric acid, diluted this solution, and used the brown acid suspension which settled out for his decolorizing tests. It was largely the acid that caused the decolorization of the caramel solution in Patterson's experiments, and not the nitrogenous precipitate itself to any great extent. This view is upheld by the fact that the addition of acid alone to a solution of caramel will considerably diminish its intensity of colour, and also by the fact that the dried precipitate possesses practically no decolorizing power. It is not intended by this American writer, however, to support the view that the impurities in a carbon have no influence on the decolorizing action, as quite the contrary is usually true. A carbon is a complex substance, and its impurities may or may not play an important rôle.

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[1] "Carboraffin" is believed to be made by Zelnicek's patent, in which carbonaceous substances are heated in the presence of zinc chloride See *I.S.J.*, 1915, 197.

[2] *Facts about Sugar*, 1922, 14, No. 21, 416.

[3] *J. Soc. Chem. Ind.*, 1903, 16, 608.

[4] *I.S.J.*, 1922, 155.

[5] *J. Ind. Eng. Chem.*, 1922, 14, No. 5, 441–443.

It is well-known that when a carbon is added to an acid sugar syrup, a greater decolorization generally results than if the liquor had been neutral or alkaline. This is due to 3 reasons: (1) some of the colouring matters (acting like indicators) lighten in colour in acid solution; (2) the solubility of colour-forming bodies (e.g., poly-phenols) may be lowered, making it easier for the carbon to adsorb them; and (3) the acid furnishs H-ions for the carbon to adsorb, causing it to be positively-charged, so as to attract the negatively-charged colour radicle of the poly-phenol colouring body, thus decolorizing the solution. OH-ions, having the reverse effect, make possible the use of alkali for the regeneration of spent carbon.

Application of existing knowledge relating to dyeing to the decolorization of sugar liquors appears to have been overlooked; but there is a remarkable analogy between the two effects. When wool is dipped in an acid dye solution (as picric acid), the dye removed will be the greater the higher the H-ion concentration; and likewise when a decolorizing carbon is mixed with an impure solution (as molasses) the colour removed depends on the H-ions in the liquid. BRADLEY[1] noticed that within limits the decolorization was nearly proportional to the acid present, and also that the efficiency of decolorization is reduced when the concentration of sugar is increased, and these observations are in accordance with theory.

Physical structure may play an important part in the behaviour of a charcoal, yet there are other factors probably more important than "cellular structure." As an example of this, a carbon was prepared from kelp juice that had decolorizing characteristics identical with those of the carbon made from the body of the kelp itself. Further, blood charcoal is far more powerful than many other charcoals made from materials of a more definite structure.

MANUFACTURE OF DECOLORIZING CARBON FROM BAGASSE.

C. E. COATES[2] has carried out a number of experiments with the object of determining the best conditions of the preparation of a good decolorizing carbon from bagasse, and the following is a summary of these tests, the decolorizing values being expressed as percentages of the efficiency of a standard char:—

Test 1.—Bagasse was charred by heating to 500-600°C. for 15-20 min., but this material still contained volatile substances. It served for the preparation of the chars to be hereafter described. Its ash was 11 per cent. Decolorizing power, nil.

Test 2.—Char from the first test was heated to 600°, the water-soluble ash removed, and the material dried. Its decolorizing power was 25.

Test 3.—Char from the second test was heated to 800° for one hour. Its decolorizing power was then found to be about 34.

Test 4.—Char from the third test was boiled for 10 min. with 15 per cent. sodium hydroxide on the weight of char, together with enough water to form a cream, the final alkali content being about 4 per cent. After washing and drying, its decolorizing power was found to be 83 to 91.

Test 5.—Char from the fourth test was boiled for 5 min. with hydrochloric acid. Its decolorizing power was 102 to 133.

Test 6.—Char from the first test was boiled with sodium hydroxide (20 per cent. on the char) for 15 min., washed with water, then with dilute acid, and dried. Ash, 3·3 per cent., and decolorizing power, 50.

Test 7.—Char from the first test was boiled with sodium hydroxide as described in Test 6, then heated to 850° for one hour. Ash, 8 per cent., and decolorizing power, 225.

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[1] *I.S.J.*, 1920, 52.

[2] *J. Ind. Eng. Chem.*, 1922, 14, No. 4, 295-298.

Test 8.—From the last experiment it was evident that the temperature of charring was of prime importance. Char obtained as in the first test was heated without treatment with sodium hydroxide to 900° for two hours, giving a char with a decolorizing power of 66.

Test 9.—Char obtained as in the eighth test was boiled for 30 min. with 20 per cent. by weight of sodium hydroxide, giving a material with a decolorizing power of 86.

Test 10.—Char from the ninth test was boiled with hydrochloric acid, and the resulting material was found to have a decolorizing power of 170.

Finally, from the experience gained in carrying out these tests, the following method was approved. Char as prepared in the first test was heated for one hour to 800-850° C., boiled for two hours with a 20 per cent. sodium hydroxide solution (water being added from time to time to maintain a fixed concentration), washed with water, boiled with hydrochloric acid (1 : 1), washed again with water, and dried by heating to about 200°. Following are the results obtained on comparison with carbons of good quality:—

	Bagasse Carbon.	"Norit."	"Darco."	Standard Carbon.
Decolorizing power	260	102	110	100
Apparent Specific Gravity	0·136	0·241	0·343	—

This bagasse carbon was therefore very low in sp. gr., and is stated to be the best filter-aid of any char tested by this writer. It was revivified with excellent results by boiling first with 5 per cent. sodium hydroxide and then with 5 per cent. HCl. It was also revivified by retorting in the usual way with even better results, it is stated. It is particularly efficient in removing the red, probably the most important colour to remove from a technical standpoint, the following being the results obtained with the other carbons: when a 3 per cent. solution of blackstrap was treated with 3 grms. of each preparation with the acidity at 0·007 N, and heating carried out by bringing the liquid to the boil, closing the flasks, and immersing in a boiling water-bath for 10 min. with occasional agitation, finally cooling, and filtering, and reading in the Hess-Ives tint photometer.

	Red.	Green.	Blue.	Total Colour Left
Standard molasses solution untreated	72	87	90	102
Treated with 3 grms. of boneblack	69	87	90	100
Treated with 3 grms. of commercial char	30	61	83	34
Treated with 3 grms. of standard char	13	35	56	14
Treated with 3 grms. of the bagasse carbon made as above described	2	12	35	5·5

Lastly, this writer mentions that if 3 grms. of the carbon after having been used once are sucked dry without washing, on using it again on another lot of the liquid under treatment, a considerable amount of colour will be removed. This operation can be repeated a number of times before all decolorizing power is lost. There would seem to be an equilibrium reached between the concentrated film of colour on the surface of the carbon. and the dispersed colour in the liquid. Just what this equilibrium is would be difficult to say, but it is now under investigation.

TECHNICAL APPLICATION OF DECOLORIZING CARBONS.

To make a fine white sugar directly from juice economically has long been the dream of the planter. During 1920 Sterling Factory, Franklin, La., did some experimenting in this direction, using "Norit," and W. H. DUNSTONE, Jr.,[1] has given an account of the operations which he conducted there.

Sterling grinds 2000 tons of cane per day, and is also equipped to operate as a refinery during the inter-season, melting 170 tons of raws per day. In addition to the factory equipment, a "Norit" plant has been installed. This consists of a three-storey steel and galvanized-iron building, containing the following apparatus:—Six 36 in. plate-and-frame presses; one Sweetland filter; two small bag filters; three mixing tanks; one wooden cistern; two storage tanks; one "Norit" kiln; and the necessary pumps.

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[1] *La. Planter*, 1922, 68, 254-256.

The first massecuite is dried in 36 in. machines and washed to 99° purity, the run-off and wash being separated while the second massecuite is dried in 30 in. centrifugals, discharged, mingled with the wash from the first massecuite, and this mingled second sugar mixed with the first massecuite, thus getting a double purging. The resulting washed sugar of 99° purity is melted up to 56° Brix, strained, heated to 200°F. (93°C.), and discharged into the mixing tanks. There it is mixed with a determined amount of the "Norit" (in the form of 50 per cent. paste), and pumped through the plate-and-frame presses, which it leaves as a practically water-white liquor from which a "beautiful standard granulated, the equal in every way of the best boneblack sugar," may be boiled.

Three "Norit" mixing tanks of about 4000 gall. each are used alternately, and the carbon is used three times (and occasionally a part four times) before being returned to the kiln to be re-burned. Two of the plate-and-frame presses are run at the same time, and in using the "Norit" the first time five tanks of liquor mixing with the carbon are pumped through the two presses in succession, the total amount of "Norit" added to the five tanks being the amount which will fill the chambers in the presses, viz., 1800 lbs. in both. The presses having been filled, the carbon cakes are discharged in order to be used a second time, on which occasion the contents of the two presses are divided between three tanks of liquor, these being sent through the two presses in succession, 900 lbs. (or the contents of one press) being dumped into one mixing tank, and 450 lbs. of half the contents of a press going into each of the two tanks following. Then the "Norit" is used a third time, the 1800 lbs. being divided equally between two tanks of liquor, and this sent into two presses.

REVIVIFICATION OF "NORIT."

After being used three times, the "Norit" in the presses is submitted to air pressure to drive out the excess of liquor remaining, and dumped into a wooden cistern of 4000 gall. capacity, equipped with a mechanical stirrer. In order to sweeten it off, water is added, the mixture heated, and pumped through another plate-and-frame press, the sweet-water being sent to the melter. Then the carbon goes to the "Norit" kiln,[1] where it is pre-dried before entering the apparatus proper. During re-burning the carbon is conveyed slowly through the retorts by conveyors inside, and the lower retort attaining a temperature of about 1100°F. (660°C.). Lastly, the carbon is discharged from the kiln into a tank of water, which prevents it from flying about, and also acts as a seal on the retorts. Periodically, the mixture of "Norit" and water is pumped up to a plate-and-frame press, after which it may be used again three times before the re-burning operation is repeated.

Liquor after being treated with the "Norit" in the manner above described is passed through small bag filters, in order to preclude the possibility of any black being introduced owing to the rupturing of a cloth.

It is lastly boiled to white granulated in the following way, four boilings being made:—Two strikes using only first liquor are boiled in succession, the run-offs from these two strikes boiled together for a second, and the run-off from the second held. This operation is repeated until the second run-off from a second boiling is obtained, when the two second run-offs are boiled for a third. This complete operation is repeated, and when two run-offs from thirds are obtained a fourth is boiled. These strikes are dried in 40 in. machines with good clean water obtained from the tail pipes on the pans. The first, second, and third sugars are all good enough to pack by themselves, but as two pans are dropping alternately, a mixture is obtained by mixing in the sugar bin. The sugar from the fourth boiling is always held until it is followed by a first with which it is mixed.

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[1] See *I.S.J.*, 1917, 431.

In drying these granulated strikes, the wash and run-off is allowed to mix together, except in the case of the last boiling, when they are separated. The wash being of a higher purity and better colour is boiled back for a second or third granulated; while the run-off of about 89° purity is mixed with the wash resulting from washing the raw sugar (which is mostly used for the mingling of the second raw sugar, as previously described, the rest being taken into the raw sugar pan, and boiled to raws).

Finally the white sugar from the centrifugals is elevated to a bin, from whence it is fed into the granulators, passing last of all into 100 lb. pockets on automatic scales. As an indication of the work done at Sterling, it is stated that the sucrose retained per cent. extracted after passing through the factory and "Norit" refinery was 90·04 in the sugars, and 6·53 in the molasses.

It is to be noted that in the above described method of applying "Norit" no pre-filtration of the melted liquor at 56° Brix is practised. Although this of course eliminates the cost of the plant which otherwise would be used, it burdens the carbon which in consequence accumulates a quantity of mineral matter. In order to reduce this ash content, it is necessary to boil the "Norit" periodically with a 2 per cent. solution of hydrochloric acid, followed at times with a 5 per cent. solution of sodium hydroxide.

In conclusion, in reference to "Norit" refining it is said that "it has been demonstrated beyond a doubt that a recovery of 93 lbs. of standard granulated per 100 lbs. of 96° raws can be obtained; and also that the process can be conducted on a commercially profitable scale."

COST OF REVIVIFICATION OF DECOLORIZING CARBON.

R. G. TILLERY[1] has also given a detailed description of the American trials with "Norit," and for those interested his account is well worth perusal. In regard to the revivification of "Norit," he says that when it has been used on high-grade liquors treatment with acid should be given every time it is regenerated with an occasional treatment with caustic soda, followed by washing with dilute acid to remove the alkali, and with reburning to remove the insoluble organic matter if the speed of filtration is below normal.

This writer also gives some interesting figures relating to the cost of revivifying "Norit" by different methods, his data being as follows, working on a basis of 400 lbs., that is the amount dealt with by one press.

Acid Treatment Only.

120 lbs. of hydrochloric acid at $1·60 per 100	$1·92
Six men at $2·50 per day $15·00, that is for 12 presses per day, or $15·00/12 per press	1·25
Per 400 lbs. of carbon	3·17
,, 1 lb. ,,	0·008

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[1] *La. Planter*, 1921, 66, 411-414; 1921, 67, 9-14.

Caustic Treatment Only.

120 lbs., pure NaOH, 160 lbs. of commercial, 75 per cent. caustic; this at $3·60 per 100 lbs.	5·76
Six men at $2·50 per day £15, that is for 12 presses per day, or $15·00/12 per press	1·25
Per 400 lbs. of carbon	7·01
,, 1 lb. ,, ...	0·0175

Re-burning Treatment Only.[1]

1500 lbs. of coke at $6·00 per ton	4·50
Eight men at $2·50 per day..	20·00
Per 4000 lbs. of carbon	$24·50
,, 1 lb. ,, ...	0·006125

Therefore, assuming the use of 1½ lbs. of carbon per 100 lbs. of raws, and also assuming a 92 per cent. yield, we have the following costs:

Acid treatment only	$0·013	per 100 lbs. of granulated.
Caustic treatment only	0·0285	,, ,,
Reburning treatment only	0 01	,, ,,
Acid and reburning treatments	0·023	,, ,,
Acid, caustic, and reburning treatments combined	0·0515	,, ,,

Hence it is evident that the caustic treatment ordinarily costs more than twice as much as the acid treatment, and the combined chemical treatment about 4 cents per lb. of granulated. Re-burning alone costs about three-quarters as much as the acid treatment; less than half as much as the caustic treatment; and less than quarter as much as the combined chemical treatment. Burning alone costs less than is usually charged off for the replacement of bone char per 100 lbs. of granulated, though the burning and chemical treatments together amount to more than twice as much as the depreciation on bone char, and the replacement value per 100 lbs. of granulated. Above figures do not make allowance for the present crude means of handling the spent carbon before it reaches the kiln. Re-burned carbon, especially with an occasional acid treatment, is so much superior to that regenerated either by the acid or by the acid and caustic methods that it is poor economy in every respect to use the chemical treatment as the only means of revivification. Re-burned carbon decolorizes better, and filters faster, its loss through revivification being also less. Moreover, the constant danger of introducing a charge of acid into the sugar solution at some point in the plant through leaks or open valves is thereby avoided.

Other than cost of installation, there are certain advantages possessed by decolorizing carbon as compared with the bone char process. There is less material in circulation; the liquor does not require to be in contact so long; and the process is more flexible. Further, laboratory experiments demonstrate that "Norit" decolorizing carbon will "hold up" after regeneration as well as bone char.

Certain chemists make the statement that decolorizing carbon will never be a commercial success until a product is produced that will be so cheap that it can be discarded after being used only once. The reply to this is that it can be regenerated to its original efficiency by reburning and an occasional acid treatment at a cost equal to the replacement cost, or the cost of revivification of bone char, so why should it be thrown away?

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[1] Capacity of kiln, 4000 lbs.

Relative Sweetness of Sucrose, Levulose and Dextrose.

By NOËL DEERR.

In this issue of the *International Sugar Journal*[1] appears an abstract of a detailed article by SALE and SKINNER comparing the sweetness of sucrose and invert sugar. Some results made by the writer some years ago giving a result different from those referred to above are briefly recorded below.

The sugars tested were sucrose, dextrose, levulose, and invert sugar. The sucrose used was a selected refinery product, and the dextrose and levulose were Kahlbaum's C.P. The invert sugar was prepared by the action of sulphuric acid in concentration of 0·5 N at a temperature of 25°C., when inversion was complete in 48 hours. After inversion the acid was nearly neutralized with baryta, neutralization being completed by adding an excess of barium carbonate. On filtration there was then obtained a solution of invert sugar containing very small quantities of barium sulphate and carbonate.

The sucrose and dextrose solutions were made up to 10 per cent. concentration by direct weighing, and the levulose and invert sugar solutions adjusted to the same concentration, using the refractive index as a basis.

The method of comparison followed was the dilution of the sucrose, levulose, and invert sugar solutions to the same sweetness as the dextrose solution.

The results found were:—

Sucrose..	100
Dextrose	60
Levulose	120
Invert sugar	95

The sweetness of the invert sugar solution does not agree with the mean of that found for the levulose and dextrose, and possibly there is no reason why exact correspondence should obtain.

The difference between this result and that found by SALE and SKINNER (sucrose 100, invert 85) may perhaps lie in the different concentration at which the sweetness was determined.

The Sugar Crop of the British West Indies for 1921.

Mr. E. H. S. FLOOD, Canadian Trade Commissioner at Barbados, has sent the following Report to the Department of Trade and Commerce at Ottawa, dealing with the exports of sugar from the British West Indies last year:—The quantity of sugar exported from Barbados, the Windward and Leeward islands, Trinidad, and British Guiana in 1921 amounted to 201,698 tons. If to this be added the fancy syrup exported, which when equated to sugar amounted to 15,129 tons, the total export of these islands for the year would be 216,827 tons. This does not include Jamaica sugar, the returns for which are not yet available; but, as the quantity estimated for export at the beginning of the season was 43,500 tons, the total export for the West Indies, including Jamaica, may be given as 260,327 tons, about 10,944 tons over the official estimate at the beginning of the season. The total export exceeded that of 1920 by several thousand tons. As compared with 1916-17, however, in both of which years the quantity exported, including the sugar equivalent of syrup, was approximately 300,000 tons, there was a decline in 1921 of some 40,000 tons.

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[1] Page 493.

In every colony except British Guiana the quantity of sugar exported was less than in the previous year. The decrease in Barbados was approximately 5700 tons, in Antigua and St. Kitts about 4300 tons, and in St. Lucia over 1000 tons. The increase, however, of 24,500 tons in British Guiana accounted for the total increase over 1920.

The following statement will show the quantity of sugar molasses and fancy syrup exported from the different colonies, taking the estimated figure for Jamaica as being correct in the year 1921:—

	Crystals. Tons.	Muscovado. Tons.	Molasses. Tons.	Syrup. Tons.
Jamaica	43,500	—	—	—
Trinidad	46,149	—	60,729	—
British Guiana	108,270	—	2	—
Barbados	23,945	2,400	5,207	36,707
Antigua	8,400	965	1,301	—
St. Kitts	7,885	249	423	7,679
Montserrat	—	30	—	—
St. Lucia	2,972	266	28	1,000
St. Vincent	—	167	965	—
Totals	241,121	4,077	68,655	45,386

Weather and the Cane Crops.

Advices from the Windward and Leeward islands are to the effect that during the growing season of last year conditions were more or less favourable, and that the crop of sugar will exceed that of last year and reach the average. Weather conditions were also favourable in Trinidad and point to an increased crop. Reports from British Guiana state that a decline of probably 10,000 tons may be looked for this year, due to extremely heavy weather, which adversely affected the cane.

A statement by the Agricultural Department of Barbados is to the effect that the present condition of the cane in the island indicates for the present year only a two-thirds crop.

The estimate for the present season for all the islands is that the sugar crop will be practically the same in quantity as in 1921.

Quality of Barbados Molasses.

During the past year from many quarters in Canada complaints have reached Barbados in respect to the quality of the molasses shipped. Careful investigation of these complaints has been made by the Agricultural Society, and it has been found that in most cases they were justified. The belief is that the decline in quality was due partly to the condition of the cane itself, and partly to a want of care in the manufacture of the molasses. It is hoped, however, that the difficulty experienced in regard to the quality and purity of the molasses has now been overcome, and that a superior article will be produced. There is such a general consensus of opinion among the planters as to the need for this improvement that the quality of this season's crop may be taken as assured.

The following statement will show the quantity of molasses exported last year from Barbados and its destination:—

Destination.	Quantity.	Value.
Canada	3,204,723 gallons.	£316,624
Newfoundland	636,410 ,,	52,342
British West Indies	8,907 ,,	818
United States	341,431 ,,	34,143

"Darco" Decolorizing Carbon.

New Factory opened in Texas.

The development of the decolorizing carbon to which the name "Darco" has been given was carried through its earlier stages at Houma, La., U.S.A. A small plant suitable for experimental work was utilized for these preliminary operations. Production was small and carbon was manufactured only in the quantities needed to determine on a plant scale its adaptability to various purposes.

As a result of the many tests conducted during the past several years it was found that a wide field of application exists for this carbon, and that it serves a highly useful purpose in many industries. The increasing demand for the product soon outgrew the capacity of the Houma plant and the manufacturers faced the problem of providing facilities for production on a large scale before offering it to the industrial world on a commercial basis.

Since lignite is the raw material for the manufacturing of "Darco," one factor in the problem was proximity to an extensive supply. Other necessities were convenient shipping facilities, and nearness to cheap and efficient fuel for use in the manufacturing process.

A happy combination of all these requirements was found at Marshall, Texas, and here the Darco Corporation has erected and put into operation at the cost of nearly $1,000,000 the largest manufacturing establishment in the world devoted to the production of decolorizing materials. The plant is located on a site of 84 acres extending along the main line of the Texas and Pacific Railroad. It comprises a group of ten buildings, which cover a total area of 66,000 sq. ft. Rail facilities from the main line of the railroad, consisting of approximately 3200 ft. of track, serve the plant and are used to bring in raw materials and to ship out the finished product.

The buildings comprising the plant are of substantial and fire-proof construction. The most noteworthy feature of their equipment is the extent to which automatic conveying and handling devices are employed. From the moment when the raw material is dumped from the cars until it emerges in neatly sealed, standardized packages of "Darco" it is handled entirely by machinery. The plant has a grinding and elevating capacity for handling 300,000 lbs. of raw lignite per day and is capable of turning out 40,000 lbs. of "Darco" daily.

The natural gas used in generating power is piped direct to the plant from the Bethany gas field. The power house, which is of brick and steel construction, is equipped with 1500 b. h.p. Babcock & Wilcox boilers and a 600 k.w. turbo-generator. Superheated steam is generated in these boilers at 200 lbs. pressure. This steam first passes through the turbo-generator and then is carried at low pressure to the main plant where it is used in process work, thus generating electrical power at a low cost.

Other units in the plant are the preparation tower in which the raw lignite is received and put into condition to start through the system; the furnace building, over 400 ft. long, in which it is subjected to heat treatment; the purification system where the furnaced product is purified; the machine shop, equipped to handle all emergency repairs and thus prevent shutdowns; the drying, packing and storage building; the change house; the pump house where water is pumped by air from deep wells, and finally the acid system. In addition there is the office building and laboratory, the latter fully equipped with all apparatus for the exact chemical control of the manufacturing process.

Realizing that the decolorizing carbon industry has been hampered in the past by the inability of manufacturers to make deliveries in large quantities, the Darco Corporation has constructed a plant of sufficient capacity to take care of all requirements likely to be put upon it. While large shipments will be made direct from Marshall, distributing stations are being established in the larger cities from which smaller or urgent orders can be filled. The executive and sales offices of the company are now located at 45 East 42nd street, New York, and 6 & 7, Stonecutter Street, London, E.C. 4.

Table showing the Possible Yield of 96° Sugar from Planters' Cane.

By CYRIL A. HINDS, Central Santa Juano, Porto Rico.

(Calculated on a factory efficiency of 100 per cent., according to the Winter-Geerligs' formula, after allowing a milling loss of 1 per cent. of sucrose on the cane.)

Per cent. Sucrose in Crusher Juice.		10 00	10·13	10·25	10·38	10·50	10·63	10·75	10·88	11·00	11·13	11·25	11 38	11·50	11·63	11·75	11·88	12·00	12·13	12·25	12·38	12·50	12·63	12·75	12·88
Per cent. Sucrose in Cane.		8·0	8·1	8·2	8·3	8·4	8·5	8·6	8·7	8·8	8·9	9·0	9·1	9·2	9·3	9·4	9·5	9·6	9·7	9·8	9·9	10·0	10·1	10·2	10·3
Purity of Juice.	70·0	5·92	6 00	6·09	6·17	6·26	6·34	6·43	6·51	6·59	6·68	6·76	6·85	6·93	7·02	7·10	7·19	7·27	7·36	7·44	7·52	7·61	7·69	7·78	7·86
	70·5	5·95	6·03	6·12	6·20	6·29	6·37	6·46	6·54	6·63	6·71	6·80	6·88	6·97	7·05	7·14	7·22	7·31	7·39	7·48	7·56	7·65	7·73	7·82	7·90
	71·0	5·98	6·07	6·15	6·24	6·32	6·41	6·49	6·58	6·67	6·75	6·84	6·92	7·01	7·09	7·18	7·26	7·35	7·43	7·52	7·61	7·69	7·78	7·86	7·95
	71·5	6·01	6·10	6·18	6·27	6·36	6·44	6·56	6·53	6·61	6·70	6·87	6·96	7·04	7·13	7·21	7·30	7·39	7·47	7·56	7·64	7·73	7·82	7·90	7·99
	72·0	6·04	6·13	6·21	6·30	6·39	6·47	6·59	6·65	6·73	6·82	6·90	6·99	7·08	7·16	7·25	7·34	7·42	7·51	7·60	7·68	7·77	7·85	7·94	8·03
	72·5	6·07	6·16	6·24	6·33	6·42	6·50	6·62	6·68	6 76	6·85	6·94	7·02	7·11	7·20	7·28	7·37	7·46	7·55	7·63	7·72	7·80	7·89	7·98	8·06
	73·0	6·10	6·19	6·27	6·36	6·45	6·54	6·65	6·71	6 80	6·88	6·97	7·06	7·15	7·23	7·32	7·41	7·49	7·58	7·67	7·76	7·84	7·93	8·02	8·10
	73·5	6·13	6·22	6·30	6·39	6·48	6·57	6·68	6·74	6·83	6·92	7·00	7·09	7·18	7·27	7·36	7·44	7·53	7·62	7·71	7·79	7·88	7·97	8·06	8·14
	74·0	6·16	6·25	6·33	6·42	6·51	6·60	6·72	6·77	6·86	6·95	7·04	7·12	7·21	7·30	·739	7·48	7·56	7·65	7·74	7·83	7·92	8·00	8·09	8·18
	74·5	6·18	6·27	6·36	6·45	6·54	6 63	6·75	6·80	7·89	6·98	7·07	7·16	7·25	7·33	7·42	7·51	7·60	7·69	7·78	7·87	7·95	8·04	8·13	8·22
	75·0	6·21	6·30	6·39	6·48	6·57	6·66	6·78	6·83	6·92	7·01	7·10	7·19	7·28	7·38	7·46	7·54	7·63	7·72	7·81	7·90	7·99	8·08	8·17	8·25
	75·5	6·24	6·33	6·42	6·51	6·60	6·69	6·90	6·86	6·95	7·04	7·13	7·22	7·31	7·40	7·49	7·58	7·67	7·76	7·85	7·93	8·02	8·11	8·20	8·29
	76·0	6·27	6·36	6·45	6·54	6·63	6·72	6·83	6·89	6·98	7·04	7·16	7·25	7·34	7·43	7·52	7·61	7·70	7·79	7·88	7·97	8·06	8·15	8·24	8·33
	76·5	6·30	6·39	6·48	6·57	6·66	6·75	6·86	6·92	7·01	7·10	7·19	7·28	7·37	7·46	7·55	7·64	7·73	7·82	7·91	8·00	8·09	8·18	8·27	8·36
	77·0	6·32	6·41	6·50	6·59	6·68	6·77	6·89	6·95	7·04	7·13	7·22	7·31	7·40	7·49	7·58	7 67	7·76	7·85	7·94	8·03	8·13	8·22	8·31	8·40
	77·5	—	—	6·52	6·61	6·70	6·80	6·92	6·98	7·07	7·16	7·25	7·34	7·43	7·52	7·61	7·70	7·79	7·88	7·97	8·06	8·16	8·26	8·34	8·43
	78·0	—	—	—	—	6·73	6·83	6·94	7·01	7·10	7·19	7·28	7·37	7·46	7·55	7·64	7·74	7·83	7·92	8·01	8·10	8·19	8·28	8·37	8·46
	78·5	—	—	—	—	—	—	—	7·03	7·12	7·22	7·31	7·40	7·49	7·58	7·37	7·77	7·86	7·95	8·04	8·13	8·22	8·31	8·40	8·49
	79·0	—	—	—	—	—	—	—	7·06	7·15	7·25	7·34	7·43	7·52	7·61	7·70	7·80	7·89	7·98	8·07	8·16	8·25	8·35	8·44	8·53
	79·5	—	—	—	—	—	—	—	—	7·18	7·27	7·36	7·46	7·55	7·64	7·73	7·83	7·92	8·01	8·10	8·19	8 28	8·38	8·47	8·56
	80·0	—	—	—	—	—	—	—	—	7·21	7·30	7·39	7·49	7·58	7·67	7·76	7·86	7·95	8·04	8·13	8·23	8·32	8·41	8·50	8·60
	80·5	—	—	—	—	—	—	—	—	—	7·32	7·42	7·51	7·60	7·70	7·79	7·88	7·98	8·07	8·16	8·26	8·35	8·44	8·53	8·63
	81·0	—	—	—	—	—	—	—	—	—	7·35	7·45	7·54	7·63	7·73	7·82	7·91	8·01	8·10	8·19	8·29	8·38	8·47	8·57	8·66
	81·5	—	—	—	—	—	—	—	—	—	—	7·47	7·56	7·66	7·75	7·85	7·94	8·03	8·13	8·22	8·31	8·41	8·50	8·60	8·69
	82·0	—	—	—	—	—	—	—	—	—	—	7·50	7·59	7·69	7 78	7·88	7·97	8·06	8·16	8·25	8·34	8·44	8·53	8·63	8·72
	82·5	—	—	—	—	—	—	—	—	—	—	—	7·62	7·71	7·81	7·90	7·99	8·09	8·18	8·28	8·37	8·47	8·56	8·65	8·75
	83·0	—	—	—	—	—	—	—	—	—	—	—	7·65	7·74	7·84	7·93	8·02	8·12	8·21	8·31	8·40	8·50	8·59	8·68	8·78
	83·5	—	—	—	—	—	—	—	—	—	—	—	7·63	7·76	7·86	7·95	8·05	8·14	8·24	8·33	8·43	8·52	8·62	8·71	8·81
	84·0	—	—	—	—	—	—	—	—	—	—	—	—	7·79	7·89	7·98	8·08	8·17	8·27	8·36	8·46	8·55	8·65	8·74	8·84
	84·5	—	—	—	—	—	—	—	—	—	—	—	—	—	7·91	8 00	8·10	8·20	8·29	8·39	8·48	8·58	8·67	8·77	8·86
	85·0	—	—	—	—	—	—	—	—	—	—	—	—	—	7·94	8·03	8·13	8·23	8·32	8·42	8·51	8·61	8·70	8·80	8·89
	85·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8·05	8·15	8·25	8·34	8·44	8·53	8·63	8·73	8·28	8·92
	86·0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8·08	8·18	8·28	8·37	8·47	8·56	8·66	8·76	8·85	8·95
	86·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8·20	8·30	8·39	8·49	8·59	8·68	8·78	8·88	8·97
	87·0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8·23	8·33	8·42	8·52	8·62	8·71	8·81	8·91	9·00
	87·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8·35	8·44	8·54	8·64	8·73	8·83	8·93	9·03
	88·0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8·37	8·47	8·57	8·67	8·76	8·86	8·96	9·06
	88·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8·49	8·59	8·69	8·78	8·88	8·98	9·08
	89·0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8·52	8·62	8·72	8·81	8·91	9·01	9·11
	89·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8·64	8·74	8·83	8·93	9·03	9·13
	90·0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8·67	8·77	8·87	8·96	9·06	9·16
	90·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8·79	8·89	8·98	9·08	9·18
	91·0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8·81	8·91	9·01	9·11	9·21
	91·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8·83	8·93	9·03	9·13	9·23
	92·0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8·96	9·06	9·16	9·26

TABLE SHOWING THE POSSIBLE YIELD OF 96° SUGAR FROM PLANTERS' CANE.—*(Continued.)*

Per cent. Sucrose in Crusher Juice.	13·00	13·13	13·25	13·38	13·50	13·63	13·75	13·88	14·00	14·13	14·25	14·38	14·50	14·63	14·75	14·88	15·00	15·13	15·25	15·38	15·50	15·63	15 75	15·88
Per cent. Sucrose in Cane.	10·4	10·5	10·6	10·7	10·8	10·9	11·0	11·1	11·2	11·3	11·4	11·5	11·6	11·7	11·8	11·9	12·0	12·1	12·2	12·3	12·4	12·5	12·6	12·7
Purity of Juice.																								
70·0	7·95	8·03	8·12	8·20	8·29	8·37	8·46	8·54	8·62	8·71	8·79	8·88	8·96	—	—	—	—	—	—	—	—	—	—	—
70·5	7·99	8·07	8·16	8·24	8·33	8·41	8·50	8·58	8·67	8·75	8·84	8·92	9·01	9·09	—	—	—	—	—	—	—	—	—	—
71·0	8·03	8·12	8·20	8·29	8·37	8·46	8·55	8·63	8·72	8·80	8·89	8·97	9·06	9·14	9·23	—	—	—	—	—	—	—	—	—
71·5	8·07	8·16	8·24	8·33	8·42	8·50	8·59	8·67	8·76	8·85	8·93	9·02	9·10	9·19	9·28	9·36	—	—	—	—	—	—	—	—
72·0	8·11	8·20	8·29	8·37	8·46	8·54	8·63	8·72	8·80	8·89	8·98	9·06	9·15	9·24	9·32	9·41	9·49	—	—	—	—	—	—	—
72·5	8·15	8·24	8·33	8·41	8·50	8·58	8·67	8·76	8·84	8·93	9·02	9·10	9·19	9·28	9·36	9·45	9·54	9·63	—	—	—	—	—	—
73·0	8·19	8·28	8·37	8·45	8·54	8·63	8·72	8·80	8·89	8·98	9·06	9·15	9·24	9·33	9·41	9·50	9·59	9·67	9·76	—	—	—	—	—
73·5	8·23	8·32	8·40	8·49	8·58	8·67	8·76	8·84	8·93	9·02	9·10	9·19	9·28	9·37	9·45	9·54	9·63	9·71	9·80	9·89	9·98	—	—	—
74·0	8·27	8·36	8·44	8·53	8·62	8·71	8·80	8·88	8·97	9·06	9·15	9·24	9·32	9·41	9·50	9·59	9·68	9·76	9·85	9·94	10·03	10·12	—	—
74·5	8·31	8·39	8·48	8·57	8·66	8·75	8·84	8·92	9·01	9·10	9·19	9·28	9·36	9·45	9·54	9·63	9·72	9·80	9·89	9·98	10·07	10·16	10·25	10·34
75·0	8·34	8·43	8·52	8·61	8·70	8·79	8·88	8·96	9·05	9·14	9·23	9·32	9·41	9·50	9·59	9·67	9·76	9·85	9·94	10·03	10·12	10·21	10·30	10·68
75·5	8·38	8·47	8·55	8·64	8·73	8·82	8·91	9·00	9·09	9·18	9·27	9·36	9·45	9·54	9·63	9·72	9·80	9·89	9·98	10·07	10·16	10·25	10·34	10·43
76·0	8·42	8·51	8·59	8·68	8·77	8·86	8·95	9·04	9·13	9·22	9·21	9·40	9·49	9·58	9·67	9·76	9·85	9·94	10·03	10·12	10·21	10·30	10·39	10·48
76·5	8·45	8·54	8·63	8·72	8·81	8·90	8·99	9·08	9·17	9·26	9·35	9·44	9·53	9·62	9·71	9·80	9·89	9·98	10·07	10·16	10·25	10·34	10·43	10·52
77·0	8·49	8·58	8·67	8·76	8·85	8·94	9·03	9·12	9·21	9·30	9·39	9·48	9·57	9·66	9·75	9·84	9·93	10·02	10·11	10·20	10·29	10·38	10·47	10·56
77·5	8·52	8·61	8·70	8·79	8·88	8·97	9·06	9·15	9·24	9·33	9·43	9·52	9·61	9·70	9·79	9·88	9·97	10·06	10·15	10·24	10·33	10·42	10·51	10·60
78·0	8·55	8·65	8·74	8·83	8·92	9·01	9·10	9·19	9·28	9·37	9·47	9·56	9·65	9·74	9·83	9·92	10·01	10·10	10·19	10·28	10·38	10·47	10·56	10·65
78·5	8·58	8·68	8·77	8·86	8·95	9·04	9·13	9·22	9·32	9·41	9·50	9·59	9·68	9·77	9·87	9·96	10·05	10·14	10·23	10·32	10·42	10·51	10·60	10·69
79·0	8·62	8·71	8·81	8·90	8·99	9·08	9·17	9·26	9·36	9·45	9·54	9·63	9·72	9·81	9·91	10·00	10·09	10·18	10·27	10·36	10·46	10·55	10·64	10·73
75·5	8·65	8·74	8·83	8·93	9·02	9·11	9·20	9·29	9·39	9·48	9·57	9·66	9·76	9·85	9·94	10·03	10·13	10·22	10·31	10·40	10·50	10·59	10·68	10·77
80·0	8·69	8·78	8·87	8·96	9·06	9·15	9·24	9·33	9·43	9·52	9·61	9·70	9·80	9·89	9·98	10·07	10·17	10·26	10·35	10·44	10·54	10·63	10·72	10·81
80·5	8·72	8·81	8·90	8·99	9·09	9·18	9·27	9·36	9·46	9·55	9·64	9·74	9·83	9·92	10·01	10·11	10·20	10·29	10·39	10·48	10·57	10·67	10·76	10·85
81·0	8·75	8·84	8·94	9·03	9·12	9·22	9·31	9·40	9·50	9·59	9·68	9·78	9·87	9·96	10·05	10·15	10·24	10·33	10·43	10·52	10·61	10·71	10·80	10·89
81·5	8·78	8·87	8·97	9·06	9·15	9·25	9·34	9·43	9·53	9·62	9·71	9·81	9·90	9·99	10·09	10·18	10·27	10·37	10·46	10·55	10·65	10·74	10·84	10·93
82·0	8·81	8·91	9·00	9·09	9·19	9·28	9·38	9·47	9·56	9·66	9·75	9·84	9·94	10·03	10·13	10·22	10·31	10·41	10·50	10·59	10·69	10·78	10·88	10·97
82·5	8·84	8·94	9·03	9·12	9·22	9·31	9·41	9·50	9·59	9·69	9·78	9·87	9·97	10·06	10·16	10·25	10·34	10·44	10·53	10·63	10·72	10·82	10·91	11·00
83·0	8·87	8·97	9·06	9·16	9·25	9·35	9·44	9·53	9·63	9·72	9·82	9·91	10·01	10·10	10·20	10·29	10·38	10·48	10·57	10·67	10·76	10·86	10·95	11·04
83·5	8·90	9·00	9·09	9·19	9·28	9·38	9·47	9·56	9·66	9·75	9·85	9·94	10·04	10·13	10·23	10·32	10·41	10·51	10·60	10·70	10·79	10·89	10·98	11·08
84·0	8·93	9·03	9·12	9·22	9·31	9·41	9·50	9·60	9·69	9·79	9·88	9·98	10·07	10·17	10·26	10·36	10·45	10·55	10·64	10·74	10·83	10·93	11·02	11·12
84·5	8·96	9·06	9·15	9·25	9·34	9·44	9·53	9·63	9·72	9·82	9·91	10·01	10·10	10·20	10·29	10·39	10·48	10·58	10·67	10·77	10·86	10·96	11·05	11·15
85·0	8·99	9·09	9·18	9·28	9·37	9·47	9·56	9·66	9·76	9·85	9·95	10·04	10·14	10·23	10·33	10·42	10·52	10·62	10·71	10·81	10·90	11·00	11·09	11·19
85·5	9·10	9·11	9·21	9·30	9·40	9·50	9·59	9·69	9·79	9·88	9·98	10·07	10·17	10·26	10·36	10·45	10·55	10·65	10·74	10·84	10·93	11·03	11·12	11·22
86·0	9·04	9·14	9·24	9·33	9·43	9·53	9·62	9·72	9·82	9·91	10·01	10·10	10·20	10·30	10·39	10·49	10·59	10·68	10·78	10·87	10·97	11·07	11·16	11·26
86·5	9·07	9·17	9·26	9·36	9·46	9·56	9·65	9·75	9·85	9·94	10·04	10·13	10·23	10·33	10·42	10·52	10·62	10·71	10·81	10·90	11·00	11·10	11·19	11·29
87·0	9·10	9·20	9·29	9·39	9·49	9·59	9·68	9·78	9·88	9·97	10·07	10·17	10·26	10·36	10·46	10·55	10·65	10·75	10·84	10·94	11·04	11·13	11·23	11·33
87·5	9·12	9·22	9·32	9·42	9·51	9·61	9·71	9·81	9·90	10·00	10·10	10·19	10·29	10·39	10·49	10·58	10·68	10·78	10·87	10·97	11·06	11·16	11·26	11·36
88·0	9·15	9·25	9·35	9·45	9·54	9·64	9·74	9·84	9·33	10·03	10·13	10·22	10·32	10·42	10·52	10·61	10·71	10·81	10·91	11·00	11·10	11·20	11·30	11·39
88·5	9·18	9·27	9·37	9·47	9·57	9·67	9·76	9·86	9·96	10·06	10·16	10·25	10·35	10·45	10·55	10·64	10·74	10·84	10·94	11·03	11·13	11·23	11·33	11·42
89·0	9·21	9·30	9·40	9·50	9·60	9·70	9·79	9·89	9·99	10·09	10·19	10·28	10·38	10·48	10·58	10·68	10·77	10·87	10·97	11·07	11·17	11·27	11·37	11·46
89·5	9·23	9·33	9·43	9·52	9·62	9·72	9·82	9·92	10·02	10·11	10·21	10·31	10·41	10·51	10·61	10·71	10·80	10·90	11·00	11·10	11·20	11·29	11·39	11·49
90·0	9·26	9·36	9·46	9·55	9·65	9·75	9·85	9·95	10·05	10·14	10·24	10·34	10·44	10·54	10·64	10·74	10·84	10·93	11·03	11·13	11·23	11·33	11·43	11·52
90·5	9·28	9·38	9·48	9·57	9·67	9·77	9·87	10·07	10·09	10·17	10·27	10·37	10·47	10·57	10·66	10·76	10·86	10·96	11·06	11·16	11·26	11·36	11·45	11·55
91·0	9·31	9·41	9·51	9·60	9·70	9·80	9·90	10·00	10·11	10·20	10·30	10·40	10·50	10·60	10·69	10·79	108·9	10·90	11·09	11·19	11·29	11·39	11·49	11·59
91·5	9·33	9·43	9·53	9·63	9·72	9·82	9·92	10·02	10·13	10·22	10·32	10·42	10·52	10·26	10·72	10·82	10·92	11·02	11·12	11·22	11·32	11·42	11·52	11·62
92·0	9·36	9·46	9·56	9·66	9·75	9·85	9·95	10·05	10·15	10·25	10·35	10·45	10·55	10·65	10·75	10·85	10·95	11·05	11·15	11·25	11·35	11·45	11·55	11·65

TABLE SHOWING THE POSSIBLE YIELD OF 96° SUGAR FROM PLANTERS' CANE.—(*Continued.*)

Per cent. Sucrose in Crusher Juice.	16·00	16·13	16·25	16·38	16·50	16·33	16·75	16·88	17·00	17·13	17·25	17·38	17·50	17·63	17·75	17·88	18·00	18·13	18·25	18·38	18·50	18·63
Per cent. Sucrose in Cane.	12·8	12·9	13·0	13·1	13·2	13·3	13·4	13·5	13·6	13·7	13·8	13·9	14·0	14·1	14·2	14·3	14·4	14·5	14·6	14·7	14·8	14·9
Purity of Juice.																						
70·0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
70·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
71·0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
71·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
72·0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
72·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
73·0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
73·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
74·0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
74·5	10·43	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
75·0	10·47	10·56	10·65	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
75·5	10·52	10·60	10 69	10·79	10·87	10·96	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
76·0	10·56	10·65	10·74	10 83	10·92	11·01	11·10	11·19	—	—	—	—	—	—	—	—	—	—	—	—	—	—
76·5	10·60	10·69	10·79	10·87	10·96	11·05	11·14	11·24	11·33	11·42	11·51	—	—	—	—	—	—	—	—	—	—	—
77·0	10·63	10·74	10·83	10·92	11·01	11·10	11·19	11·29	11·38	11·47	11·56	11·65	11·74	—	—	—	—	—	—	—	—	—
77·5	10·69	10·78	10·87	10·96	11·05	11·1[illegible]	11·24	11·33	11·42	11·51	11·60	11·69	11·78	11·87	11·97	—	—	—	—	—	—	—
78·0	10·74	10·83	10·92	11·01	11·10	[illegible]	11·29	11·38	11 47	11·56	11·65	11·74	11·83	11·92	12·01	12·10	12·20	12·29	—	—	—	—
78·5	10·78	10·87	10·96	11·05	11·14	[illegible]	11·33	11·42	11·51	11·60	11·69	11·78	11·87	11·97	12·06	12·15	12·24	12·33	12·42	12·51	—	—
79·0	10·82	10·91	11·01	11·10	11·19	·28	11·37	11·47	11·56	11·65	11·74	11·83	11·92	12·02	12·11	12·20	12·29	12·38	12·47	12·57	12·66	12·75
79·5	10·86	10·95	11·05	11·14	11·23	11·32	11·41	11·51	11·60	11·69	11·78	11·87	11·96	12·06	12·15	12·24	12·33	12·43	12·52	12·61	12·70	12·80
80·0	10·91	11·00	11·09	11·18	11·28	11·37	11·46	11·55	11·64	11·74	11·83	11·92	12·01	12·11	12·20	12·29	12·28	12·48	12·57	12·66	12·75	12·85
80 5	10·95	11·04	11·13	11 22	11·32	11·41	11·50	11·59	11·68	11·78	11·87	11·96	12·05	12·15	12·24	12·33	12·43	12·52	12·61	12·70	12·80	12·89
81·0	10·99	11·08	11·17	11·27	11·36	11·45	11·54	11·64	11·73	11·82	11·92	12·01	12·10	12·20	12·29	12·38	12·48	12·57	12·66	12·75	12·85	12·94
81·5	11·02	11·12	11·21	11·30	11·40	11·49	11·58	11·68	11·77	11·86	11·96	12·05	12·14	12·24	12 33	12·42	12·52	12·61	12·70	12·79	12·89	12·98
82·0	11·06	11·16	11·25	11·34	11·44	11·53	11·63	11·72	11·81	11·91	12·00	12·09	12·19	12·28	12·38	12·47	12·56	12·66	12·75	12·84	12·94	13·03
82·5	11·10	11·19	11·29	11·38	11·48	11·57	11·67	11·76	11·85	11·95	12·04	12·13	12·23	12·32	12·42	12·51	12·60	12·70	12·79	12·88	12·98	13·07
83·0	11·14	11·23	11·33	11·42	11·52	11·61	11·71	11·80	11·89	11·99	12·08	12·18	12·27	12·37	12·46	12·56	12·65	12·74	12·84	12·93	13·03	13·12
83·5	11·17	11·27	11·36	11·46	11·55	11·65	11·74	11·84	11·93	12·03	12·12	12·22	12·31	12·41	12·50	12·60	12·69	12·78	12·88	12·97	13·07	13·16
84·0	11·21	11·31	11·40	11·50	11·59	11·69	11·78	11·88	11·97	12·07	12·16	12·26	12·35	12·45	12·54	12·64	12·73	12·83	12·92	13·02	13·11	13·21
84·5	11·25	11·34	11·44	11·53	11·63	11·72	11·82	11·92	12·01	12·11	12·20	12·30	12·39	12·49	12·58	12·68	12·77	12·87	12·96	13·06	13·15	13·25
85·0	11·29	11·38	11·48	11·57	11·67	11·76	11·86	11·96	11 05	12·15	12·24	12·34	12·43	12·53	12·62	12·72	12·82	12·91	13·01	13·10	13·20	13·29
85·5	11·32	11·41	11·51	11·60	11·70	11·80	11·89	11·99	12·08	12·18	12·28	12·37	12·47	12·57	12 66	12·76	12·85	12·95	13·05	13·14	13·24	13·33
86·0	11·35	11·45	11·55	11·64	11·74	11·84	11·93	12·03	12·12	12·22	12·32	12·41	12·51	12·61	12·70	12·80	12·89	12·99	13·09	13·18	13·28	13·38
86·5	11·38	11·48	11·58	11·68	11·77	11·87	11·97	12·06	12·16	12 26	12·35	12·45	12·55	12·64	12·74	12·84	12·93	13·03	13·13	13·22	13·32	13·42
87·0	11·42	11·52	11·62	11·72	11·88	11·91	12·01	12·10	12·20	12·30	12·39	12·49	12·59	12·68	12·78	12·88	12·97	13·07	13·17	13·26	13·36	13·46
87·5	11·45	11·55	11·65	11·75	11·84	11·94	12·04	12·13	12·22	12·33	12·42	12·52	12·62	12·72	12·81	12·91	13·01	13·11	13·20	13·30	13·40	13·50
88·0	11·49	11·59	11·69	11·78	11·88	11·98	12·08	12·17	12·27	12·37	12·46	12·56	12·66	12 76	12·83	12·93	13·05	13·15	13·24	13·34	13·44	13·54
88·5	11·52	11·62	11·72	11·81	11·91	12·01	12·11	12·20	12·30	12·40	12·50	12·59	12·69	12·79	12·89	12·99	13·08	13·18	13·28	13·38	13·48	13·58
89·0	11·56	11·65	11·75	11·85	11·95	12·05	12·14	12·24	12·34	12·44	12·54	12·63	12·73	12·83	12·93	13·03	13·12	13·22	13·32	13·42	13·52	13·61
89·5	11·59	11·68	11·78	11·88	11·98	12·08	12·17	12·27	12·37	12·47	12·57	12·67	12·76	12·86	12·96	13·06	13·16	13·26	13·35	13·45	13·55	13·65
90·0	11·62	11·72	11·82	11·92	12·02	12·11	12·21	12·31	12·41	12·41	12·61	12·71	12·80	12·90	13·00	13·10	13·20	13·30	13·39	13·49	13·59	13·69
90·5	11·65	11·75	11·85	11·95	12·05	12·14	12·24	12·34	12·44	12·54	12·64	12·74	12·83	12·93	13·03	13·13	13·23	13·33	13·43	13·53	13·62	13·72
91·0	11·68	11·78	11·88	11·98	12·08	12·18	12·28	12·38	12·48	12·58	12·68	12·77	12·87	12·97	13·07	13·17	13·27	13·37	13·47	13·57	13·66	13·76
91·5	11·71	11·81	11·91	12·01	12·11	12·21	12·31	12·41	12·51	12·61	12·70	12·80	12·90	13·00	13·10	13·20	13:30	13:40	13·50	13:60	13·70	13·80
92·0	11·75	11·85	11·95	12·04	12·14	11·24	12·34	12·44	12·54	12·64	12·74	12 84	12·94	13·04	13·14	13·24	13·34	13·44	13·54	13·64	13·74	13·84

American Commerce Reports.[1]

THE BELGIAN SUGAR INDUSTRY.

About half of Belgium's sugar output is exported, and large quantities of raw and some refined sugar are imported, mostly between March and September. Most of the raw-sugar importing is done by refineries, an important factor in Belgian business, some of which produce 300 to 400 tons of sugar per day. Antwerp is also an important shipping point for granulated sugar passing through to Germany and other European countries. Business is usually done through brokers acting as agents for large American houses.

All the raw sugar imported into Belgium is cane sugar, mostly from Cuba, Brazil, Peru, and the Dutch East Indies. In 1920 imports totalled 56,200 and in 1921, 13,400 metric tons. There was a large increase in the first three months of 1922, the imports amounting to 7000 tons. The principal importing season is just starting, and it is predicted that imports in 1922 will almost equal those of 1920.

Belgian raw sugar is manufactured from domestic sugar beets and beets imported from the Netherlands. About 382,000 metric tons of sugar beets were imported into Belgium from September, 1921 (the beginning of the sugar year), to March, 1922, compared with 201,000 tons in 1920-21 and 111,000 tons in 1919-20. The refining of home products starts in October and lasts until March, when importation starts. Belgian production of refined sugar in 1921-22 is estimated at 290,000 tons, of which about 150,000 tons will be consumed in Belgium and the rest exported.

Quotations for raw cane sugar come from Havana, London, and Paris; the principal Paris quotations are for South American sugar. London quotes prices for Cuban raw sugar, but most of the buying of Cuban sugar is done through Habana houses. Dutch East Indian sugar is quoted direct and through Amsterdam and London. Shipments are generally direct from the exporting country. Cuban refined sugar is generally quoted from New York, with some quotations from London. London and Paris quote prices for other West Indian refined sugar, as well as refined sugar from various sources. The Cuban sugar refined in the United States is known to the trade under the name of "American granulated 100 per cent."

Belgian refineries make a poorer quality of sugar than American, known as 99 per cent. pure. They specialize in loaf sugar, lumps, and fine crystallized sugars. The crystallized sugar is much finer than granulated, not so clean, and of poorer quality. Brokers handling American granulated speak of the high qualities of the American sugar but say that the general public does not appreciate the difference, and importation of refined sugar is possible only when home refineries are unable to supply the home market or when their prices are high. The transit trade in refined sugar is said to be greater than imports for home consumption. Prices are generally higher for home-refined products from March to September, when the home refineries are importing raw sugar.

Belgian crystallized sugar is protected by a duty of 40 francs per 100 kg. or about $0·015 per lb. avoirdupois at the present rate of exchange, which will naturally become higher as the Belgian franc strengthens. With the present rates of exchange and duties, American granulated is quoted at prices about equal to the Belgian crystallized. Brokers say that American granulated is well liked in other European markets served through the port of Antwerp, and on account of its price is able to compete. They predict that more than normal quantities of American granulated sugar will be imported through the port of Antwerp this season.

The present stocks of raw and refined sugar are considered very small, and refineries are obliged to import raw sugar. Prices for Belgian refined sugar are firm. German stocks are said to be low. There is an increasing demand for American granulated.

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[1] Culled from "Commerce Reports," published by the Department of Commerce, Washington. In many cases these are abbreviated here.

Stocks of refined and raw sugar in Belgium at the end of April were 56,000 metric tons compared with 92,000 tons on the same date in 1921 and 48,000 tons on the same date in 1920.

During the seven-month period from September, 1921, to March, 1922, Belgian imports of raw sugar amounted to 10,922 metric tons and of refined to 2668 tons. Exports of raw sugar during the same period were 115,703 tons.

The following table shows the Belgian imports and exports of different kinds of sugar, by countries of origin and destination, in 1920 and 1921 :—

Belgian Imports and Exports of Sugar.

KINDS OF SUGAR AND COUNTRIES OF ORIGIN. IMPORTS.	1920 METRIC TONS.	1921 METRIC TONS.
Raw cane sugar	56,249	13,369
Brazil	1,579	2,136
Cuba	32,786	92
Dutch East Indies	2,740	7,186
Peru	5,224	2,043
Refined sugar	1,519	1,509
EXPORTS.		
Raw beet sugar	1,600	25,708
France	—	18,743
Netherlands	1,600	1,900
Refined sugar:—		
Candy sugar	5,438	4,395
Loaf, lumps, powder	26,809	27,939
France	1,188	5,401
Morocco	1,965	3,066
KINDS OF SUGAR AND COUNTRIES OF ORIGIN. EXPORTS—continued.	1920 METRIC TONS.	1921 METRIC TONS.
Refined sugar—continued		
Loaf, lumps, powder—continued		
Persia	8,672	3,341
Spain	3,398	2,068
United States	2,814	1
British India	1,269	5,097
Powder for manufacturing purposes	38,230	118,149
France	4,363	12,157
Italy	385	6,712
Netherlands	19,012	8,135
Spain	3,922	4,028
Switzerland	10	4,410
Turkey	885	8,892
United Kingdom	360	57,964

The Acting British Consul at Tamsui states that with the Formosan sugar season 1921-22 nearing its close the total actual production has been estimated at 5,970,000 piculs [say, 355,350 long tons], the area under cane being 383,250 acres.

Central Delicias (Cuban American Sugar Co.) has achieved record in turning out a million bags of sugar during the course of the last campaign, a milestone in the development of sugar production.[1] Up to July 31st, 1922, the average rate of grinding was 109·51 tons of cane per hour, and the largest amount of cane handled in any day was 8520 tons; the daily sugar production for the season has averaged just under 7000 bags, and the maximum for one day was 7252 bags. Delicias is equipped with 3 Fulton tandems, each having double crushers and 15-roller mills.

Planters in the Philippines who in exchange for their cane receive a share of the 96° sugar made from it by the mill are now being induced to dispose of their product through the "toll refining contract" system.[2] This means that he ships the sugar to the American refiners, who refine and market it, deducting from the proceeds of such sales the refining expenses and taking as a marketing toll a small percentage of the net proceeds (generally 5 per cent). Further, the refiner advances 50 per cent. of the market value of the sugar at the time of shipment, 25 per cent. when the sugar enters the refinery, and the balance immediately the sugar is sold. As compared with the usual system of selling to a local merchant, this procedure may give a profit of about 5 per cent. Thus last year planters received $9·41 per picul for their sugar as sold through the refiners' organization, as compared with $9·00 sold locally (calculated in Philippine dollars in both cases).

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[1] *Facts about Sugar*, 1922, 15, No. 8, 147.

[2] *Sugar News*, 1922, 3, No. 6, 251-254.

Publications Received.

De Suikermachinerieën. By J. Landman, Jr. (Wed. J. Ahrend & Zoon's Boekhandel en Uitgevers-maatschappij, Amsterdam, Holland.) 1922.

This is an illustrated description of apparatus and collection of data relating to the several stages of the cane sugar manufacture, and has evidently been written for the use of the young factory engineer. It relates more particularly to Java practice, and gives information relating to subjects as: cane unloaders, carriers, cutters, shredders, and crushers; systems of mills; comparison of results obtained with three and four unit installations; determination of the capacity of mills; and the driving of mills. Under juice purification, the apparatus described includes: mechanical juice strainers; milk-of-lime mixing tanks; carbonatation tanks; CO_2 pumps; defecation pans; scum pumps and filter-presses. Under evaporation and boiling, the juice level, calculation of the heating surface, central condensation, pans and accessories, are discussed; while further there are chapters on crystallizers and centrifugals. Lastly, there are various tables and formulas among which mention may be made of those relating to milling under different conditions in Java; steam consumption in several systems of evaporation (taken from Claassen's book), and a useful summary of the capacity and heating surface of all the apparatus necessary in factories crushing from 100 to 1400 tons of cane per day. Generally the information is of an elementary nature, and it is clearly and accurately stated. It should prove a useful hand-book for the young Dutch engineer.

An Economic Study of Farm Tractors in New York.[1] By W. I. Myers. Bulletin 405 of 1921. (Cornell University Agricultural Experiment Station, Ithaca, New York, U.S.A.)

Contents: Methods of study; description of the regions studied; costs of tractor operation; annual use of tractors; tractor equipment; effects of use of tractors on farm organization; tractor ploughs; summary.

Relative Toxicity of Strychnine to the Rat. By Erich W. Schwartze. Bulletin No. 1023. (U.S. Department of Agriculture, Washington, D.C., U.S.A.) 1922. Price: 5 cents.

Die Zuckerrube: kurzgefasste, gemeinverständliche Beschreibung, mit einem zerlegbaren farbigen Modell. By A. Schleyer. (Pestalozzi Verlagsanstalt, Wiesbaden, Kosmos, Stuttgart.) 1922.

Handbuch der landwirtschaftlichen Pflanzenzüchtung: Die Züchtung von Mais, Futterrüben und anderen Rüben. By C. Fruwirth. (Paul Parey, Berlin.) Two volumes; 4th edition. 1922.

Centrifugal Pumps. John W. Cameron, A.M.I.Mech.E. (Scott, Greenwood & Son, London.) 1921. Price: 12s. 6d. net.

Physico-Chemical Problems relating to the Soil: Report of a General Discussion held under the auspices of the Faraday Society, May 31st, 1921. (The Faraday Society, 10, Essex Street, Strand, W.C. 2.) 1922. Price: 10s. 6d.

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[1] *I.S.J.*, 1922, 229.

Correspondence.

LEWIS SELF-DISCHARGING CENTRIFUGAL BASKETS.

To the Editor, "The International Sugar Journal."

Sir,—There have been of late a number of discussions with reference to the self-discharging basket which the Cresson-Morris Company are putting out, and which was first installed at Crockett, one company claiming that these baskets are not new and have been in use since 1894, while others have claimed that they originated them.

In order to set at rest these reports, I have written up a short history of the Lewis Self-Discharging Basket which is given in the following paragraphs, as I think that it should be published in order to clear up the conflicting views held on the subject.

In 1916 the writer, then Secretary of W. J. Wayte, Inc., furnished the California & Hawaiian Sugar Refining Co., with an experimental centrifugal machine, equipped with a regular self-discharging basket. This machine was installed in their Crockett Refinery and they found that it would not discharge clean every time with Hawaiian sugar. Experiments were then made by their engineers, under the direction of Mr. Alphonse Duperu, assistant manager of the company, and from the data which these engineers obtained, the basket which was subsequently installed on their washing station, and which is now known as the Lewis Self-Discharging Basket, was designed under the direction of the writer, and installed on the setting furnished them. In 1919 the writer carried out about six weeks' experiments on these new machines, and the present type of basket, which is now a perfect success, was the result of these experiments.

The bottom which is used in the new basket has a slope of 30 degrees from the perpendicular, and the opening in the bottom is made as large as possible, all obstructions being removed, the hub being made as small as practicable and the arms are shaped so as to form no obstruction to the material when it is being discharged. The material being centrifugalled is dropped on to a flat disc midway of the basket and located at the point which is adjusted by experiment so as to build up a straight wall with massecuite, which is either thick or thin. During experiments it was found that each basket has a personal equation with reference to the location of this disc, and in a battery of 14 machines at the Baltimore Refinery there are only two discs the same distance from the top.

With free drying sugar it is not necessary to stop the basket for it to discharge. When braking speed is down to 35 r.p.m. the load drops out and as the basket is charged while running, the machine is immediately started up and it is only necessary to stop the machine to wash the screen, which is done about once an hour.

All the baskets of this type that have been built in the past and are now being built for installation have been made under the writer's directions at the shops of the Cresson-Morris Co., Philadelphia, and are furnished to all the Morris-Weston machines either belt, water, steam, or electrically driven.

Yours very truly,
D. J. Lewis, Jr.,
Sales Agent, Cresson-Morris Co.

Woolworth Buildings, New York.

Messrs. Willett & Gray give their first estimate of the American 1922 beet crop as 600,233 acres and 650,000 long tons of sugar, a considerable drop from the previous year's achievement of 817,388 acres and 911,190 long tons.

Dr. E. F. Armstrong, D. Sc., F.R.S., author of "The Simple Carbohydrates and the Glucosides," a work well known to sugar chemists, has been elected President of the Society of Chemical Industry. Formerly Dr. Armstrong carried out a good deal of useful research on carbohydrates and enzyme action Latterly he has taken up a technical business career, and for the past few years has been Managing Director of Joseph Crosfield & Sons, Ltd., William Gossage & Sons, Ltd., and of a number of associated companies, engaged in the soap and chemical industries.

Review of Current Technical Literature.[1]

CULTIVATION OF THE BEET, AND METHODS OF MANUFACTURE (DIFFUSION, CARBONATATION, BOILING AND CURING) FOLLOWED AT OXNARD, CAL., U.S.A. *A. Vasseux. Bull. Assoc. Chim. Sucr., 38, No. 10, 409-435.*

A useful account is given of the methods employed at Oxnard,[2] where in spite of the very low purity of the roots, viz., 80-82°, as much as 97 per cent. of the sugar present is extracted as white granulated. *Cultivation of the Beet.*—All the soils of the district are relatively low in humus and rich in mineral matter, and contain an excess of sodium salts, chlorides, sulphates and carbonates (so called "alkali soils"), which appear on the surface as efflorescences, the beet as one of the rotation crops being given the task of absorbing to some extent these sodium compounds. Rain never falls from May to October; but there are heavy night dews, and irrigation is everywhere practised.

It is difficult, if not impossible, to express true average figures for the weight of roots per acre, the sugar content of the roots, and the purity of the juice, since these data vary so considerably; but on well cultivated fields (such as ordinarily are reserved for haricot beans) they may be 20-22 tons, 18-22 per cent., and 85-89°. Whereas in Europe, the richer the root, the purer the juice, there appears to be no such correlation in these soils of Ventura, Cal. Regarding the cost of cultivation, this is stated to be about $66·75 per acre producing 20 tons of roots containing 18 per cent. of sugar. Seed formerly imported from Germany, France, and other countries is now grown locally so successfully as to lead the writer of this article to predict that the future holds the possibility of America sending some of her special strains to the old world, so extraordinary have been some of the results obtained. For harvesting the crop, caterpillar lifting machines can be used on the hard ground, Mexican or Japanese labourers following behind to scour the foliage. In payment of the roots furnished to the factory, the farmers are given a certain share up to about 66 per cent. of the money obtained for the sugar made after deducting the manufacturing expenses.

Diffusion and Carbonatation.—During diffusion the temperature is maintained at 85°C. in seven out of the eleven cells of the battery, and work is carried out very rapidly, under which conditions enzyme action is inhibited and a juice of high density with good extraction results. Liming is carried out with the calcium sucrate from the Steffen process of treating the molasses, using 5·25 of CaO per 100 of roots. First carbonatation is carried to 0·73, after which the juice is heated to 92°C., filtered, heated to 98°C., re-filtered, treated with sodium carbonate for the precipitation of the lime salts, carbonated to 0·26, and heated to boiling, the alkalinity being lowered to 0·16 before the juice passes to the evaporators. It is then very light in colour, as is also the syrup leaving the evaporators.

Boiling.—Evaporator syrup, mixed with the second sugar, is heated, sulphited to an alkalinity of 0·23, mixed with kieselguhr (using ½lb. per ton of roots), pumped successively through presses and Daneks, thus giving so-called "first liquor," which is very light in colour, and low in viscous substances, as the result of these treatments. It has a density of about 65° Brix and a purity of 86–88°. The first strike is made with this liquor after it has been mixed with the rich centrifugal syrups, which themselves have also been sulphited, treated with kieselguhr, and twice filtered, the resulting massecuite having a Brix of 66° and a purity of 80°. Boiling is carried out with great rapidity. This is made possible by the addition to the pan of a small amount of white sugar of uniform size just at the moment when grain is about to form, which addition not only facilitates boiling, but obviates the formation of false grain, gives a sugar of better colour, and improves the extraction. It should also be said that this rapid boiling would probably not be possible were it not for the combined sulphitation, kieselguhr, and filtration treatment, which, though it does not greatly increase the purity value, yet surely eliminates colloidal, viscous and colouring substances. This massecuite is immediately turbined, using 40 in. machines provided with a washing apparatus invented by Mr. Selier (Chief Engineer of the factory), the run-offs being separated automatically, and the sugar discharged while the centrifugal is still running[1]. Then the second sugar is boiled. This is done by bringing the molasses from the first to a purity of about 72° with some of the rich run-off, and sulphiting, treating with kieselguhr, and filtering, as in the case of the first liquor, white sugar grain being drawn into the pan as before. This massecuite is dropped into crystallizers where the temperature is lowered from 85 to 60°C. in 50-60 hours, and then more slowly to 54° at which degree it is centrifuged.[2] This second sugar as already stated is dissolved in the evaporator syrup to form the first liquor; while the molasses goes to the Steffen plant. Some control figures are given, and these show in the case of the 1919 campaign: total sugar in the roots, 18·71; remaining in the pulp, 0·11; in the diffusion waste waters, 0·03; in the scums, 0·08; in the Steffen waters, 0·17; actually the sugar bagged was 18·21 or 97·35 per cent. while 0·06 or 0·30 per cent. remained over to be worked up next season. In 1919 Oxnard sliced 223,162 tons of roots, and produced 40,638 tons of sugar as well as 264,711 bags (of 100 lbs. each) of dry pulp.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*

[2] One of the six factories of the American Beet Sugar Company.

Process of Manufacture used at the Usine Ste. Madeleine, Trinidad, B.W.I.

W. Scott. Ste. Madeleine Quarterly Review, 1921, 1, No. 1, 9-11; No. 3, 7-11.

Cane reaches the factory in railway trucks which are weighed several at a time on a Fairbank's scale, then divided between the two cane carriers feeding the two trains of mills. The first (East) tandem consists of a set of levelling knives, a Krajewski crusher, a Searby shredder, and a 12-roller mill, maceration being effected by returning the thin juices from the 3rd and 4th mills to the bagasse from the 1st and 2nd, applying also 3rd mill juice to the shredded cane entering the 1st; while water is also used in front of the 3rd and also between the 3rd and 4th mills. The second (or West) tandem consists of a set of levelling knives and a 9-roller mill, including a "Diamond" top roller on the first to partly perform the duties of a crusher, maceration being carried out by returning the 3rd mill juice to the bagasse between the 1st and 2nd mills, while water is applied between the 2nd and 3rd, this water being the condensate from the 3rd and 4th calandrias of the evaporators. Juice from both sets of mills is delivered to the liming tanks where it is measured and treated with a sufficiency of milk; but when making "washed greys," it first goes through a sulphur tower before reaching the tanks where it is limed, compressed air being used to effect a thorough mixing of the lime and juice. After passing through the heaters, the juice goes to the settling tanks, is subsided for about an hour and a half, decanted off, and led to the evaporator supply tanks, the mud being treated as ordinarily by a second subsiding and then filter-pressing. Concentration of the juice in the evaporators is carried to 30·0° Bé. (54·8° Brix). In boiling, the two-massecuite system is followed (no pure syrup massecuites being made), the second sugar which results (the polarization of which is about 90°) being mingled with first molasses, and this magma led to the mixer containing the first massecuite, the whole of which is purged as 96° sugar. The total for the 1921 crop was 17,421 tons of sugar, of which 16,208 were grey crystals, 1340 washed greys, and 135 molasses sugars, the balance being massecuite for curing in 1922. Of the canes ground, 84,000 tons were grown on the estates of the usine, and 102,000 by farmers, the yield per acre being 20·75 tons, and 10·37 tons of cane were required per ton of sugar, the sucrose in the cane averaging 11·45 per cent., and the yield of sugar per acre for all estates 2·07 tons. Regarding the destination of the sugars, 43·5 went to the United Kingdom, 22·5 to Eastern Canadian ports, 25·3 to Vancouver, while the remainder 8·4 per cent. was disposed of locally.

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[1] One man suffices for two machines.

[2] There are 27 machines, and it is said that four men only are required for the attendance of these.

Review of Current Technical Literature.

QUALITY OF THE LIME USED IN MAURITIUS FOR CLARIFICATION, AND ITS IMPROVEMENT.

P. A. Bour and E. Wuthrich. *La Revue Agricole de l' Ile Maurice, 1922, 1, No. 2, 62–71.*

Instead of containing at most 10 per cent. of impurities (the maximum specified by Dr. GEERLIGS[1]), the lime in general use in Mauritius for the clarification of sugar juices has about 27 per cent. of unburnt coral rock in it, and sometimes in addition about 8 per cent. of other constituents, such as sodium and magnesium chlorides, calcium sulphate, and iron and aluminium oxides. It is therefore rather an impure product; whereas care should be taken to use this material in as pure a state as possible. Mr. WUTHRICH in a letter to Mr. BOUR emphasizes this, pointing out that his experience has shown him that an impure lime means a rapid accumulation of incrustation in the re-heaters. If it contains 27 per cent. of unburnt limestone, it also means that $\frac{27 \times 100}{100-27}$ or 37 per cent. more must be used in order to effect a complete clarification (the other impurities not being considered), the amount of scums which results being proportionately increased, being for example 1·6 per cent of the cane, instead of 1·0 if a normally pure lime were employed. If one assumes the sucrose in the scums to average 9·15 per cent. for Mauritius factories, then the amount of sucrose lost solely as the result of using an inferior lime is 0·055 per cent. of the cane, which means about 1100 tons of sugar for the whole crop annually. Yet the coral rock from which this low-grade lime is made is fairly pure, containing according to Mr. DE SORNAY[2] about 94 per cent. of calcium carbonate; while the coral sand at Mauritius shows a similarly satisfactory analysis. Now in the territory of Hawaii excellent lime suitable for use in clarification is made by the Maui Agricultural Co. from limestone in the form of powder or sand in a rotatory kiln, 50 ft. long, such as is used in the manufacture of Portland cement in different countries, for the operation of which three men only are necessary, a quarter of the number required for working an ordinary lime kiln. Mr. BOUR therefore urges manufacturers in Mauritius to adopt the rotatory kiln system for the burning of coral sand, in order thus to produce a lime containing 90–95 per cent. of CaO much more economically than is done at the present time, and more rapidly too, as it could be made almost as soon as required, instead of having to be stored for three or four months before grinding commences. In the discussion following the reading of this paper at the Chemical Society of Mauritius, Mr. DE SORNAY said that he hardly thought that a pure lime would have all the advantages claimed, while he believed that the impure lime used in Mauritius actually facilitated the filtration of the scums, because the limestone present had the effect of spacing out the mud. In fact (it was asserted) if one used a pure lime, filtration would be hindered, unless kieselguhr were employed.

INVERT SUGAR, ITS SWEETNESS AND PREPARATION.

J. W. Sale and W. W. Skinner. *Journal of Industrial and Engineering Chemistry, 1922, 6, No. 14, 522–525.*

It is commonly stated that a nett increase in sweetness is gained by the conversion of sucrose into invert sugar,[3] a difference that should be detected with certainty by anyone with a normal sense of taste. Tests were therefore undertaken (U.S. Department of Agriculture) to test the validity of this claim in the Water and Beverage Laboratory. Physiologists have developed standard psychophysical procedures for the determination of stimulus limen, difference limen, etc.;[4] and in some previous experiments made in the Water and Beverage Laboratory,[5] the stimulus limens of four sugars were obtained, their relative sweetness being calculated with the following results: sucrose, 100; dextrose, 50; levulose, 150; and maltose, 60; while Paul's results, obtained in the ordinary way, gave the following values[6]: sucrose, 100; dextrose, 52; levulose, 103; and lactose, 28. Bearing in mind the various factors which influence taste,[6] the present authors have carried out a series of careful tests, by direct tasting, to establish the relative sweetness of sucrose and invert sugar, the opinions of four different observers being recorded. The nett results showed that if sucrose is assigned a value of 100, that of invert sugar is only 85, but since 100 units of sucrose by inversion become 105 of invert sugar, the nett loss in sweetening power by the inversion of 100 units of sucrose is about 11 units. Regarding the methods of preparing the invert sugar syrups, good results were obtained by boiling the solution of sucrose (1 kg. per litre of water) for 20 mins. with 0·013 per cent. by weight of hydrochloric acid (C.P., 37 per cent. concentration), or for 40 mins. with 0·021 per cent. of tartaric acid crystals. Invert sugar syrups thus made were practically without colour or flavour, but gave a slightly unpleasant harsh sensation. On the other hand syrups made with invertase and concentrated by boiling *in vacuo* possessed only a slight candy flavour, and were remarkably smooth when taken in the mouth, being altogether superior to those prepared by means of mineral or vegetable acids.

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[1] "Cane Sugar and its Manufacture"

[2] "La Canne à Sucre à l'Ile Maurice," p. 637. [3] *I.S.J.*, 1919, 84.

[3] RICHARDS, *Amer. Chem. J.*, 1898, **20**, 121; GIBSON and HARTMANN, *Amer. J. Physiol.*, 1919, **30**, 311.

[4] *Southern Carbonator and Bottler*, June, 1918. [5] *Chemiker Zeitung*, 1921, **45**, 705.

[6] "The Sense of Taste," by HOLLINGWORTH and POFFERBERGER, page 44.

EXTRACTION OF SUGAR FROM BEET MOLASSES USING THE BARYTA PROCESS. *Camille Deguide and Paul Baude. Comptes rendus, 1922, 174,* 1177-1179.

In the baryta process the barium oxide is ordinarily obtained by the decomposition of barium carbonate at a temperature of 1600°C. or thereabouts, but this operation involves certain difficulties since the product fuses and attacks the walls of the furnace. M. DEGUIDE (a Belgian chemist) recently took out a patent,[1] however, for a process in which 400 kg. of barium carbonate is heated in a rotatory or other suitable furnace with 60 kg. of silica (both these substances being in a very finely ground condition) at a temperature of about 1280°C., according to the following equation: $SiO_2 + 2\,BaCO_3 = Ba_2SiO_4 + 2CO_2$, dibarium silicate therefore being formed. This compound, which is infusible in the neighbourhood of the temperature named, on being mixed with an equal weight of water reacts in the following way: $Ba_2SiO_4 + XH_2O = BaSiO_3 + Ba(OH)_2 8H_2O$, and the paste thus obtained is used for the precipitation of the sucrose from the solution of molasses under treatment, thus: $BaSiO_3 + XH_2O + Ba(OH)_2 8H_2O + H_2O + C_{12}H_{22}O_{11} = BaSiO_3, XH_2O + C_{12}H_{22}O_{11} BaO$, which insoluble mixture of barium silicate and barium saccharate is filtered off, washed, and carbonated, the sugar being liberated and the barium carbonate and the barium silicate recovered. This mixture of barium compounds is dried, and again sent to the furnace for the regeneration of the dibarium silicate compound, the process thus being a continuous one. It is said that in the production of 1000 kg. of barium hydrate in this way, about 232 kg. of coal would be required. It is further claimed that practically no loss of baryta occurs when working according to this process.

POSPISIL PROCESS FOR THE MANUFACTURE OF DIRECT CONSUMPTION SUGAR IN THE BEET FACTORY. *Ed. Kurek.*[2] *Zeitsch. Zuckerind. cechoslov. Republik, 1921, 45* (iii), *No. 27, 308.*

This is an extolment of the process of boiling white granulated, patents for which were recently taken out by the author and R. C. POSPISIL.[3] It is said that in spite of the improvements instituted by CLAASSEN and other technologists, difficult boiling, film formation in the centrifugals and the like still persist. All existing processes work up the molasses "cold," obtaining products of low purity, which must be washed and steamed, molasses of high purity and sugar of inferior quality being the result. These difficulties are, however, removed in the Pospisil process, which must be regarded as the most perfect method of after-product working, as it gives low sugars always having 96° polarization. Refining costs coal and therefore much money, but if every sugar factory were to produce direct consumption sugar (which is possible by the Pospisil process) a desirable change would be effected. A drum dryer for the sugar is the only new installation required. Every technologist would welcome a process capable of boiling an after-product strike in two hours, and of completing centrifuging in another two hours, while giving only 2½ per cent. of molasses with a purity of 50–55°, besides economizing in steam to the extent of using 2 per cent. less coal. Furthermore, it is stated, even when owing to poor roots the purity of the syrup is only 72·75, the Pospisil process always yields a prime sugar, and it obviates an after-campaign.

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[1] French Patent not yet published.

[2] Of Chippewa Falls (Wisconsin) Sugar Co., U.S.A.

[3] *I.S.J.*, 1912, 480; 1921, 58.

ELECTROLYTIC CLEANING OF THE SURFACES OF HEATERS AND EVAPORATORS BY THE CUMBERLAND PROCESS. *Brunolf Brukner. Die deutsche Zuckerindustrie, 1921, 46, 759.*

In the production of steam when using rather saline water, in order to avoid the scaling on the heating surfaces it has been proposed that zinc plates should be placed in the boilers and connected to the walls, so that a galvanic element is formed. In this way, hydrogen gas is generated on the heating surfaces, and the deposition of solid matter is largely prevented. Cumberland's modification of this process,[1] in which the current is not generated inside the vessel, was recently described by Prof. PHILIPPI. He makes the boiler wall the cathode; while an iron tube inserted into the wall of the boiler at such a position that it is always below the water-level (and suitably isolated by means of rubber or asbestos) serves as the anode, the current being supplied from a 10-volt circuit. In this manner a slight generation of hydrogen gas takes place on the walls of the boiler, the bubbles liberated being sufficient almost to completely inhibit any incrustation. Cumberland's process (it is stated by the writer of this note) may be applied in the heaters and evaporators of the sugar factory; but in this application an iron anode is inapplicable, since it would cause iron to go into solution in the juice, and therefore one of carbon should be used in its place. Using a current of 0·02 amp. per sq. metre, this at 10 volts for an evaporator of 500 sq. m. of h. s. is equivalent to 100 watts, that is as much as is consumed by a 100 candle-power metallic filament lamp, a small expense, against which one may contrast the cost of so much hydrochloric acid, Sunday labour, and wear and tear of heating surface and scraping implements. Besides, one must consider that such a process continuously maintains a clean surface, and the effect of this on the steam consumption and the total efficiency of heating or evaporation constitutes a considerable advantage in the long run. In regard to the danger of inversion of sucrose, it is stated that this is not to be feared so long as the liquid remains alkaline.

DIRECTIONS FOR EFFECTING MUTUAL CHEMICAL CONTROL IN RAW BEET FACTORIES IN GERMANY. *Vereinszeitschrift, 1922, No. 796, 297-348.*

Directions are given for sampling and analysing the various products arising in the manufacture of beet sugar commencing with the roots and finishing with the final molasses, as drawn up by a special commission of the directorate of the Vereins der deutschen Zuckerindustrie. Methods of working adopted by the Institute für Zuckerindustrie in the analysis of raw sugar; of sampling and analysing limestone, brown coal and coke; of examining flue gases; and of determining heat losses through flue gases are also given. Finally the following tables are printed: Domke's for ascertaining the concentration of sugar solutions from the apparent specific gravity at 20°C.; temperature corrections below and above 20°C.; comparison between Brix, old Baumé degrees and the apparent density.

LOSS OF SUGAR IN THE REFINERY DURING RE-MELTING (IN THE WORKING OF BEET RAWS). *J. E. Duschsky and P. G. Galabutsky. Vereinszeitschrift, 1922, No. 797, 401-416.*

Laboratory experiments carried out by the authors before the war at Kief led to the conclusions that during the re-melting of sound "sand sugar," it is unnecessary to add lime or other alkali, since under these conditions, whether a coil or direct steam be the means of heating, the amount of inversion that occurs can hardly be detected. On the other hand, when working with sand sugar which contains invert sugar, and has become more or less acid as the result of having been stored for some time, matters are different. During the solution of such sugar the amount of the alkali added must be so regulated that the alkalinity of the resulting syrup is hardly apparent, and does not exceed 0·001 per cent. expressed as CaO. A greater excess of alkali is irrational, since it leads to an increase of the soluble salt content of the syrup, and consequently to a greater amount of final molasses, and also causes the darkening of the liquors, necessitating a greater char consumption for their decolorization. During the re-melting of deteriorated sugars, solution must be effected as quickly as possible, and every possible means should be adopted for realizing this, such as, the use of suitable mechanical stirrers, and the application of direct steam for heating. Further, any delay of the syrups in the pans should be avoided as much as possible, as this likewise leads to an increase in reducing substances, which may be small in the case of sound sand sugar, but more considerable in that of a deteriorated grade.

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[1] *Siemenszeitschrift*, May number of 1921.

Correction for the Volume of the Precipitate when using Basic Lead Nitrate as Clarifying Agent in the Double Polarization Method of determining Sucrose. C. Sijlmans. *Archief, 1920, 30, No. 29, 517-520.*

In the new method of clarification for the direct polarization in the double polarization or Clerget method of determining sucrose, using lead nitrate solution followed by sodium hydroxide,[1] a considerable precipitate is produced, for which it is now found necessary to make allowance. This is done by making two polarizations, the new method of clarification being applied in both, but a determined amount of sucrose being added in the second. Thus, in making the first polarization, 35·82 grms. of the molasses (or other product) were treated in a 250 c.c. flask with 30 c.c. of lead nitrate solution (600 grms. per litre), then with 30 c.c. of sodium hydroxide (80 grms. per litre), the liquid mixed, made up to the mark, again mixed, and filtered, after which a 100-110 c.c. flask was filled to the lower mark with the filtrate, saturated aluminium sulphate solution added to complete the volume almost to the 110 c.c. mark, the exact adjustment being made with water, a little kieselguhr added, and the liquid shaken, filtered, and finally polarized. In the second polarization, 33 grms. of white sugar (polarizing 99·5) was added to the 25·82 grms. of molasses, after which the procedure was exactly as described, both polarizations being of course increased by one-tenth. One of the determinations gave the following figures: first polarization, 16·08; second, 67·25; polarization value of the sugar added, 50·42; so that the volume of the precipitate produced was 3·7 c.c., or 1·5 per cent. This *modus operandi* was applied to a number of molasses, the average result obtained being 3·2 c.c., equivalent to 1·26 per cent. It follows, therefore, that the results given by this new method of working (which has been adopted as an official process for use in Java sugar factories[2]) are on the average 1·26 per cent. too high, so that if the direct polarization of a sample were found to be 34·0 by this basic lead nitrate method, the actual value should be 33·6.

Thornycroft's Continuous Beet Diffusion Apparatus. Anon. *Engineering, 1922, 113, 315-317.*

As disadvantages of the present mode of extraction of juice from the roots by means of a diffusion battery, it is said that the apparatus is bulky, costly in installation, demands considerable attention in connexion with passing the "sirop" round; and allows of much loss and heat by radiation. On the other hand, the apparatus invented during the war by Sir John Thornycroft[3] is a single chamber occupying little space, and is automatic excepting in connexion with the supply of the beet and the drawing off of the juice. It is stated to be in commercial operation in France, and it is said that trials have proved very satisfactory, diffusion having been shown to be as complete as with the multi-cell system, while in first cost in labour charges it is said to compare very favourably with its older rival. A plate showing 38 figures is published in connexion with this article illustrating the apparatus very fully.

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[1] *I.S.J.*, 1921, 627-629.

[2] It is included in the latest edition of Java Bulletin No. 11, which prescribes the methods of analysis to be used in the mutual chemical control of that country.

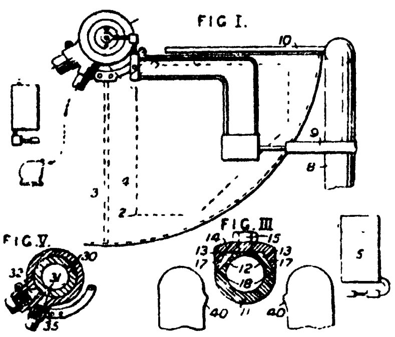
[3] *I.S.J.*, 1919, 146.

Review of Recent Patents.[1]

UNITED KINGDOM

VACUUM FILTERING APPARATUS FOR SUGAR JUICES. *Wilhelm Mauss*, of Johannesburg, Union of South Africa. *181,123.* March 8th, 1921.

Deposit is removed from the surface of a vacuum filter leaf by a thin continuous sheet of water impinging at a slight inclination with a high velocity while the leaf and nozzle are moved relatively to one another, the invention being applied to a filter for sugar juice of the type described in specification *176,395* which was recently published[2]. Filter leaves *2* are mounted on a hollow shaft *1* which oscillates to dip the leaves alternately into a juice tank *3* and a stripping-tank *4*. The hollow shaft is provided at the end with a plug cock with ports *30*, *31*, Fig. V, which, as the shaft oscillates, register respectively with ports *32*, *35* in the cock casing to put the filter leaves under vacuum while in the tank *3* and to supply air under pressure while the leaves are in the tank *4*. The nozzles *10* are arranged as shown in Figs. I and III, one nozzle between each pair of leaves and slightly above the leaves when the latter are immersed in the tank *4*. They are supplied with water under pressure from an accumulator *5* by a main *8*. Each nozzle consists of a pipe *11*, Fig. III, with perforations *12* which discharge into spaces *13* between the pipe and the crown strip *14*, attached to the pipe by screws *15*. The edges *17* of the strip are thinned down to seat on machined surfaces *18* on the exterior of the pipe. The pressure of the water slightly raises the edges *17* enabling the water to escape as a thin sheet. A valve *9* in the main *8* is automatically operated from the shaft so that the jets cut away the cakes from the leaves as the latter pass the nozzles in rising from the tank *4*. The severance is assisted by a slight rucking of the filter canvas at the points *40*, Fig. III, due to the impingement of the water jet and the internal air pressure.



FILTER FOR SUGAR LIQUORS. *Léon Tottereau*, of Paris, France. *180,935.* July 21st, 1921.

Claim is made for a filter comprising a revoluble horizontal cylinder mounted upon rollers, said cylinder comprising a longitudinal collector in which terminate nozzles upon which the filtering pockets are attached, the liquid to be filtered entering under pressure through a tubular socket arranged at one of the ends of the cylinder traversing the filtering pocket from the outside to the inside to collect in the collector from whence it flows out of the filter in a clean state through a tubular socket arranged at the other end of the cylinder.

WEIGHING APPARATUS FOR JUICE AND SUGAR. *Baltus Boulogne*, of Soerabaja, Java. *181,303.* January 24th, 1921.

In an automatic weighing-machine for liquids or granular materials, of the kind in which after each discharge from the weighing-receptacle a residue is left behind, the weight beam consists of a bent lever provided with a counterbalance weight for restoring the receptacle to filling position with the requisite residue therein. In Fig. 1 is shown a machine for weighing liquids, the weighing receptacle *1* being arranged to rotate in a counter-clockwise direction for the purpose of discharging its contents. In the operation of the machine, the liquid from the supply chamber passes through valves *20*, *30* and enters the weighing receptacle *1*. The rise of the liquid in the receptacle causes the receptacle to rotate in a clockwise direction until arrested by contact of a stop *72* against a suspension rod *3*. Further filling of the receptacle rocks an intermediate lever *4*, *5* through which the receptacle is suspended from the bent weigh-beam *8*, *9*. The curved end *54* of the intermediate lever is withdrawn from beneath a lever *52* which falls on to a stop *56*, whilst the arm *5* of the intermediate lever pushes back and liberates a rod *24* connected by a bell-crank lever *23* to the main valve *20* and to a lever *47* on the lever *52*. The main valve *20* then closes under its own weight. When the weight of liquid is completed through the small valve *30*, the bent weigh-beam *8*, *9* rotates and an arm *57* integral with the beam knocks up and liberates a rod *39* connected to a pivoted catch pan *38* which falls to a position beneath the feed valves. The movement of the catch pan allows a counterweighted lever *33* to fall and push up the valve *30* to stop the feed. Owing to the rotation of the weigh-beam *8*, *9*, a pin *15* on the receptacle *1* engages a fixed guide *16* and causes the receptacle to rotate into the lower position shown in dotted lines and allow the liquid to run out at the nozzles *11*, *12*, until the receptacle is returned by the counter-weight *10*. The return movement resets the parts in the position shown in Fig. 1. The arm *57* is connected by a pin *60*, loop *62* and lever *63*, to a dash-pot *69* for absorbing shock. The pin-and-loop connexion *60*, *62* leaves the weigh beam free of the shock absorbing device in its extreme position. In a modification, the shock-absorber is coupled to the weigh-beam arm *9*.

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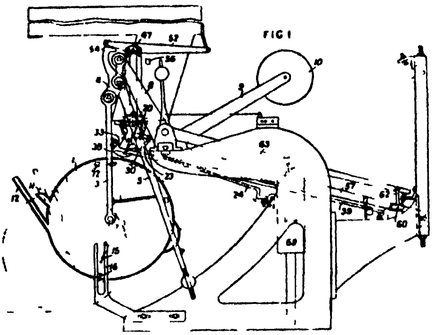
[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2fr. 00 each).

[2] *I.S.J.*, 1922, 328.



PREVENTION OF FORMATION OF EVAPORATOR SCALE. *G. Schicht A.-G and K. Schnetzer*, of Obersedlitz, Czecho-Slovakia. *180,696*. May 29th, 1922; convention date, May 27th, 1921.

To prevent the formation of deposits on the heated parts of an evaporator, the parts are connected by electric conductors to one pole of a suitably insulated source of electricity with or without an interrupter in the circuit.

MACHINES FOR BREAKING BLOCKS OF SUGAR INTO PIECES AND PLACING THEM IN BOXES. *Société des Raffinerie et Sucrerie Say Soc. Anon., and Louis Chambon*, of Paris. *180,906*. June 7th, 1921.

The invention consists in causing all the movements of the different operating parts of a machine to occur in an intermittent and automatic manner so that three blocks of sugar can be dealt with simultaneously without intervention on the part of the attendant in charge. The movement of all the parts being controlled by the movements of the shaft of the breaking device, perfectly synchronous movements of those parts are obtained.

ALCOHOL DISTILLATION COLUMNS. *Carl Still and Hermann Petsch*, of Westphalia, Germany. *179,745*. March 16th, 1921.

It is the purpose of the invention to avoid a separate pre-heating apparatus. Accordingly the wash is fed to a heater constructed as an intermediate member between the distilling column beneath it and the rectifying column above it.

UNITED STATES.

Indicator and Caliper Gauge for the Trash Turner of Mills. *William Langmeier*, of St. Louis, Miss., U.S.A. *1,421,604.* July 4th, 1922. (Four drawings ; five claims.)

The invention consists of a thin flexible metal base strip *1*, having retaining guide points *2* punched upwardly therefrom, the same remaining attached to the strip at their outer ends, and their free ends being slightly raised and bent inwardly to form the said guide points *2*, which are adopted to slidingly receive and hold the superimposed indicator slide *3*. This indicator slide *3* is likewise of thin flexible metal, but less in width than the base strip *1*, so as to permit its being slidingly passed within the guide points *2* of the base strip. One end of the indicator slide *3* is turned up to form a handle *4*. Two sets of hinged caliper arms *5* and *6* are mounted over the indicator slide *3* and at approximately opposite ends thereof. These sets of caliper arms *5* and *6* are each made of two relatively short, thin metal strips 7 and *8*, equal in length and hinged together at *9*, and having the ends of the strips 7 hinged to the base strip *1*, and the ends of the strips *8* hinged to the indicator slide *3*. The hinging to the base strip may be neatly accomplished by striking up ears *10* from the base strip and passing pins *11* through these ears and securing them to the ends of the strips 7 in any suitable manner. The hinging to the indicator slide may be made in a similar way or by any ordinary hinge, as *12*. An indicator point *13* is extended from the hinge *9* of the set of caliper arms *6*, the set nearest the handle *4*.

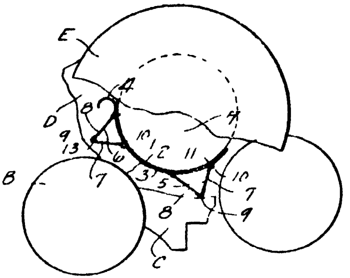


Fig. 1

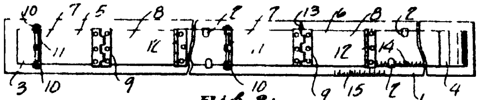


Fig. 2

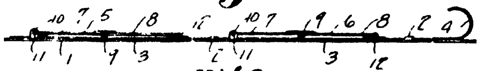


Fig. 3

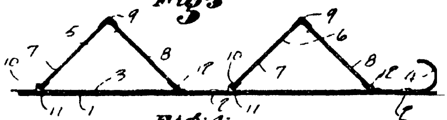


Fig. 4

In use, the indicator slide *3* is drawn back over the base strip *1* by pulling upon the handle *4*, and this act folds the set of caliper arms *5* and *6* close to the base strip, as shown in Fig. *3*. The end of the stool opposite the handle is then passed down between the top roll *A* and the front roll *B* of the cane mill, the base strip *1* being turned up flat against the top roll. This brings the set of caliper arms *5* immediately over the turn plate *C*, and then by pressing forward on the handle *4*, both sets of caliper arms, *5* and *6*, are caused to spread out equally, until the hinges *9* of the inner caliper arms *5* strike against the surface of the turn plate *C*. Then by passing the caliper arms *5* back and forth over this turn plate, with the hinge *9* thereof always in contact with the plate, the distance of the surface of the turn plate *C* from the top roll *A* at all points is accurately registered by the caliper arms *5* and transmitted to the caliper arms *6*, and by holding a strip of tracing paper *D* against the inside of the flange *E* of the roll *A*, and pressing the indicator point *13* against the paper, an accurate tracing is readily made, showing the gauge of the turn plate *C* relative to the top roll *A*. Thereafter any required readjustment of the turn plate *C* may be quickly made by manipulation of the usual screws and other elements provided for that purpose in standard mills. Calibrations *14* and *15* may be marked on the indicator slide and base strip respectively, to facilitate the use of the tool.

PRESERVATION OF SYRUPS AND MOLASSES IN STORAGE. *William L. Owen*, of New Orleans (assignor to *Penick & Ford, Ltd.*). *1,418,457*. June 6th, 1922. (One drawing; three claims).

In general the method consists in subjecting the syrup or molasses in a suitable container to carbon dioxide gas under pressure, and then releasing the pressure within the container until the entrained air is substantially removed, finally subjecting the same to a maintained pressure of carbon dioxide gas. In carrying out the process, the syrup or molasses is first introduced into an "impregnator," comprising a suitably constructed enclosed tank, where it is subjected to a pressure of carbon dioxide of substantially 75 lbs. per sq. in., injected into the body of molasses or syrup by means of a pipe provided with a suitably formed nozzle. The carbon dioxide being injected at the bottom of the contents of the container, thoroughly subjects the molasses to the action of the gas. To remove particles of air in the molasses or syrup, the pressure within the tank is then released through a suitable valve, and the syrup or molasses again subjected to the pressure of the carbon dioxide, which treatment is repeated until substantially all of the air contained within the syrup or molasses, and above the same in the tank, is removed. The syrup or molasses thus freed of air is transferred, by means of a valved conduit, to a storage tank, where it is again subjected to a maintained pressure of carbon dioxide gas injected through a pipe provided with a suitably constructed nozzle extending along the bottom of the tank so as to force the gas under pressure up through the body of the liquid, as above described. In order to maintain the pressure within this tank to the required degree (which in the present case should be about 45 lbs. per sq. in.) there is provided a regulating device of any suitable character, and to this end a pipe is provided connecting with the uppermost part of the tank and leading to the carbon dioxide supply pump whereby the pressure within the tank may be automatically controlled. This storage tank is also provided with a safety valve. When it is desired to release the syrup or molasses from storage, the same is conducted, by means of a valved conduit to a "carbon dioxide eliminator" which comprises a tank into which is injected compressed air by means of a pipe, also formed with a nozzle at the base thereof which is adapted to inject air up through the body of the liquid. The eliminator is further provided with a valved outlet for withdrawing the syrup or molasses to be further processed and canned. It will be evident that instead of repeatedly subjecting the molasses to pressure of the carbon dioxide, and alternately releasing the pressure within the "impregnator" to gradually displace the entrained air with carbon dioxide, a substantially similar result may be accomplished by continuously subjecting the liquid to the pressure of carbon dioxide and permitting the entrained air thus gradually diluted to continuously escape through the release valve. After air has been thus substantially removed or displaced, the liquid can be transferred as aforesaid to the storage tank, and there subjected to the maintained pressure of carbon dioxide.

FILTER, USING GRANULAR MEDIA (e.g. SAND). *Albert L. Genter* (assignor to *United Filters Corporation*, of New York). *1,405,406*. February 7th, 1922. (Two drawings; eight claims).

Claim 3: In a filter, the combination of a casing adapted to contain a granular filter material, a vertical pipe arranged in said casing and having its lower end inserted into said filter material, a removable nozzle arranged under the lower end of said pipe and in line therewith, means for supplying wash liquid under pressure to said nozzle, and means for adjusting said nozzle relatively to the lower end of said vertical pipe.

TOWER FOR DISTILLING COLUMN. *Frank E. Lichtenthaeler* (assignor to the *Walter E. Lummus Co.*, of Boston, Mass.). *1,424,173*. August 1st, 1922.

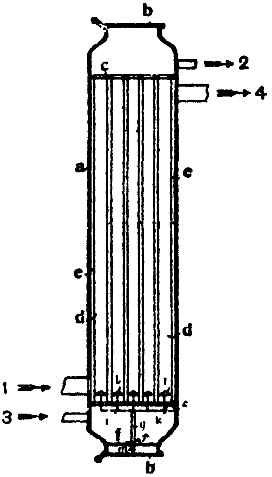
Claim 1: A tower for distillation and similar processes having in combination an outer casing, a plurality of transverse decks adopted to divide the interior of the casing into compartments, means for supporting one of the decks, and means co-operating with the other decks and arranged so that the latter are supported by the first-mentioned deck.

Patents.

GERMANY.

Retort for the Manufacture of Decolorizing Carbon. *Alfred Schclz*, of Karlstadt a. M., Germany. *336,797*. June 15th, 1919; published, May 19th, 1921.

One of the main difficulties in the production of decolorizing carbon on the large scale is the very low heat conductivity of the charcoal which is to be raised to a high temperature. Consequently, it is necessary to carry out this heating in comparatively narrow tubes, placed preferably in a vertical position for the purpose of easy charging and discharging. It is the purpose of this invention to provide a retort having a large total cross section, in which the carbon can be submitted to the heating and reaction gases at a high temperature while being uniformly and sufficiently heated. Referring to the drawing *a* is the shell of the retort, the neck of which is constricted and carries the gas-tight cover *b*. The tubes *d* are beaded into the end-plate *c*, the heating space *e* between the tubes being thus completely separated from the rest of the area of the retort. In order to prevent the carbon falling through the tubes, these are closed by a simultaneously-acting device so formed that each tube has its separate seal. In the orifice *f*, a vertically movable rod *g* is fixed in position by means of a wedge. To the upper end of this rod *g* is attached the cross-bar *i*, bearing the rods *k*, to the upper end of each of which is fixed the conical seals *l*, *l*. These conical seals are perforated, in order to permit the reaction gases to enter each single tube. Further, the rod *g* bears at its lower end the attachment *m*. When emptying the retort, the lower man-hole cover *b* is removed, and the rod *g* pulled down. Then the finished product flows downwards over the conical seals, *l*, *l*. Filling of the retort is effected by opening the cover *b*, and running the raw material into the single tubes, *d*. Heating gases enter the retort through the conduct *1* and leave through *2*; while the reaction gases enter through *3* and leave through *4*. This retort may be operated under pressure or under vacuum, *2* being either closed or connected to a vacuum pump. Its shell may be carefully isolated, and arrangements may be made for heating it externally by building it in, if so desired.



Process for the Regulation of the Work of the Crystallizers. *C. Rudolph & Co., and Adolph Hinze,* of Magdeburg-Neustadt, Germany. *344,013*. January 31st, 1920; published, November 12th, 1921.

It is well recognized that the final concentration in the pans should reach a certain optimum degree, otherwise, when too low, treatment of the mass in the crystallizers will be too prolonged; while on the other hand, when it has been allowed to proceed too high separation of fine grain may occur in consequence of a strong super-saturation. According to this invention, the most favourable conditions are obtained by effecting an after-concentration in the crystallizers. The object is attained by first inducing a partial crystallization of the super-saturated liquid when discharged into the crystallizers; and then bringing the mass into intimate contact with a dry heated gas or gaseous mixture (e.g., air). This heated gas or air serves a double purpose: firstly, it maintains the contents of the crystallizers at a certain high temperature, whereby any undesirable increase in the super-saturation owing to cooling is avoided; and secondly, it causes a further concentration of the mass. In this way crystal formation takes place in a satisfactory manner.

Sugar Crops of the World.

(Willett & Gray's Estimates of Crops to August 10th, 1922.)

	Harvesting Period.	1921-22. Tons.	1920-21. Tons.	1919-20. Tons.
United States—Louisiana	Oct.-Jan.	289,699	150,996	108,035
Texas	,, ,,	2,920	6,238	None
Porto Rico	Jan.-June	385,000	438,494	433,825
Hawaiian Islands	Nov.-July	490,000	508,392	496,183
West Indies—Virgin Islands	Jan.-June	5,000	4,500	12,400
Cuba	Dec.-June	4,000,000	3,936,040	3,730,077
British West Indies—Trinidad	Jan.-June	52,000	54,933	58,416
Barbados	,, ,,	35,000	24,817	54,279
Jamaica	,, ,,	35,000	40,000	46,875
Antigua	Feb.-July	10,500	11,320	15,540
St. Kitts	Feb.-Aug.	8,000	8,063	10,036
Other British West Indies	Jan.-June	10,000	3,603	5,651
French West Indies—Martinique	Jan.-July	27,000	27,000	19,097
Guadeloupe	,, ,,	32,000	25,426	22,847
San Domingo	Jan.-June	225,000	185,546	175,736
Haiti	Dec.-June	10,000	5,625	4,125
Mexico	,, ,,	110,000	115,000	92,000
Central America—Guatemala	Jan.-June	19,000	17,500	15,100
Other Central America	,, ,,	18,000	20,000	20,000
South America—				
Demerara	Oct.-Dec. and May-June	90,000	96,168	85,356
Surinam	Oct. Jan.	10,000	12,000	7,169
Venezuela	Oct.-June	16,000	15,000	18,000
Ecuador	Oct.-Feb.	7,000	6,998	7,628
Peru	Jan.-Dec.	325,000	350,000	330,000
Argentina	May-Nov.	175,000	202,158	298,709
Brazil	Oct.-Feb.	325,000	340,063	177,155
Total in America		6,712,089	6,605,880	6,244,239
Asia—Brit. India (consumed locally)	Dec.-May	2,500,000	2,448,000	3,049,157
Java (1922-23—1,625,000)	May-Nov.	1,649,610	1,508,755	1,335,763
Formosa and Japan	Nov.-June	425,000	342,176	283,482
Philippine Islands, *exports*	,, ,,	276,000	255,843	209,336
Total in Asia		4,850,610	4,554,774	4,877,738
Australia (1922-23—300,000)	June-Nov.	298,701	182,401	162,298
Fiji Islands	,, ,,	65,000	73,000	88,000
Total in Australia and Polynesia		363,701	255,401	250,298
Africa—Egypt (consumed locally)	Jan.-June	100,000	79,706	86,712
Mauritius	Aug.-Jan.	200,000	259,572	235,490
Réunion	,, ,,	38,593	42,079	32,336
Natal	May-Oct.	150,000	151,500	142,851
Mozambique	,, ,,	52,000	50,000	38,746
Total in Africa		540,593	583,157	536,135
Europe—Spain	Dec.-June	5,000	6,886	6,048
Total cane sugar crops		12,471,993	12,006,098	11,914,458
Europe—Beet sugar crops		4,087,729	3,671,575	2,585,488
United States—Beet sugar crop	July-Jan.	911,190	969,419	652,957
Canada—Beet sugar crop	Oct.-Dec.	18,931	34,600	16,500
Total beet sugar crops		5,017,850	4,675,594	3,254,945
Grand total Cane and Beet Sugar	**Tons**	**17,489,843**	**16,681,692**	**15,169,403**
Estimated decrease in the world's production	**,,**	**808,151**	**....**	**....**

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1922. Tons.	1921. Tons.
Total Receipts, January 1st to August 30th	2,977,890	1,835,888
Deliveries ,, ,,	2,933,132	1,840,383
Meltings by Refiners ,, ,,	2,788,573	1,779,844
Exports of Refined ,, ,,	785,000	227,000
Importers' Stocks, August 30th	44,758	6,557
Total Stocks, August 30th	191,332	96,603
	1921.	1920.
Total Consumption for twelve months	4,107,328	4,084,672

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1919-1920, 1920-1921, AND 1921-1922.

(Tons of 2,240 lbs.)	1919 20 Tons	1920 21. Tons	1921-22 Tons.
Exports	2,988,988	1,602,897	2,851,391
Stocks	383,868	1,410,886	640,464
	3,372,856	3,013,783	3,491,855
Local Consumption	55,700	75,000	87,500
Receipts at Ports to July 31st	3,428,556	3,088,783	3,579,355

Havana, July 31st, 1922 J. Guma.— L. Mejer.

Beet Crops of Europe.

(Willett & Gray's Estimates to August 10th, 1922.)

	Harvesting Period.	1921-22. Tons.	1920-21. Tons.	1919-20. Tons.
Germany	Sept.-Jan.	1,330,000	1,152,960	739,548
Czecho-Slovakia	Sept.-Jan.	659,907	705,919	493,781
Hungary and Austria	Sept.-Jan.	68,322	47,977	12,151
France	Sept.-Jan.	275,000	305,041	154,444
Belgium	Sept.-Jan.	300,000	242,589	146,918
Holland	Sept.-Jan.	370,000	316,402	238,692
Russia (Ukraine, Poland, etc.)	Sept.-Jan.	100,000	89,071	78,013
Poland	Sept.-Jan.	225,000	189,834	140,000
Sweden	Sept.-Jan.	227,000	164,194	145,072
Denmark	Sept.-Jan.	145,000	134,835	152,852
Italy	Sept.-Jan.	200,000	135,484	182,843
Spain	Sept.-Jan.	135,000	170,722	81,650
Switzerland	Sept.-Jan.	5,500	3,710	8,550
Bulgaria	Sept.-Jan.	22,000	7,837	10,974
Rumania	Sept.-Jan.	25,000	5,000	....
Total in Europe (1922-23, 4,500,000)		4,087,729	3,671,575	2,585,488

Sugar Market Report.

Our last report, under date 23rd August, 1922, was published late in the month, on account of the Printers' strike.

Although values show but little change on balance since that date, there has been in the short period that has elapsed a sharp and somewhat erratic movement. The decidedly weak tendency that then existed continued for a few days, when a quick reaction ensued, under which some 9d. to 1s. per cwt. recovery from lowest prices was made. At the extreme lowest, December delivery in our Terminal market touched 20s. 6d., after an almost uninterrupted decline from 22s. 7½d.,—the highest point reached in the early days of August,—and by the end of the month had advanced again to 21s. 6d , at about which point it remained, with minor fluctuations. At time of writing, prices are rather lower, December being quoted at 21s. During the past few days an official quotation has been established in this market for the months of January to May, 1923, and business has been done in May at 21s. 9d. up to 22s. and back again to 21s. 6d.

The decline was reflected in the values of actual white sugars to a more pronounced extent than in the case of the Terminal contract; Belgian Crystals, during the period in question, receded from 20s. 6d. to 19s. 3d. Oct./Dec. f.o.b. Antwerp, whilst White Java Crystals, c i f. London marked a similar decline. On the rebound, these sugars reached a value of 20s. f o.b. for Belgians, Oct./Dec., and 20s. 3d. for White Javas July shipment, 20s. for August shipment c.i.f. London. It may be noted that Java Crystals for July shipment c.i.f. U.K. were dealt in during August as high as 22s. 3d. and as low as 19s. 3d. Second-hand sales of American Granulated on the Spot were made down to 49s., and back to 50s., whilst September shipment has been quoted at 23s. 3d. c.i.f. U.K., a price considerably below American parity. West India Crystallised has been in slow demand at prices from 42s. to 45s. according to quality. In the last week of August, London Refiners' quotations were reduced by 1s 6d. for Spot and Nov./Dec. and 1s. 9d. for Oct. delivery, but on more active trade enquiry, prices were yesterday advanced 6d. for Spot and 3d. for Oct. and Nov./Dec. Tate's No. 1 Cubes now stand at 58s. 3d., London Granulated at 51s. 3d. spot, duty-paid.

Upon the whole, a feeling of uncertainty with regard to the immediate outlook has been aroused by the recent sharp fluctuations in prices, influenced from the American side, and it is not surprising that the Trade have preferred to restrict themselves to the buying of their immediate requirements. There is, however, some disposition to regard the possibilities of the more distant future as being in favour of higher prices, and this may lead to a growing interest in forward deliveries, for beyond the requirements of the present, the Trade have made practically no provision.

The demand from India for Java sugars has remained quiet. White Javas, Oct./Dec. shipment c. & f. Calcutta basis, after being quoted down to 20s. 9d., have been more recently on offer at 21s. 3d to 21s , although second-hand sellers are to be found who would probably consider proposals at some 3d. per cwt. below the latter figure. Only a small business is reported. It is estimated that the quantity remaining for sale ex the present crop in the hands of the Java Trust does not exceed 50,000 tons. Latest reports from Java indicate a quiet market. A small business is said to have been done there in Sept./Oct at 13½ guilders and in Oct./Nov. at 13 5/16 guilders first cost, which marks a decline of about ⅜ guilder from the recent highest. There is still a considerable quantity of sugar held by shippers and speculators (estimated in some quarters to be some 450,000 tons), but in view of the comparatively small demand so far met from the Indian market, it is but reasonable to expect that eventually a considerable, and perhaps active, enquiry may yet be seen from that quarter.

Cuba is reported to be holding the balance of its crop very firmly, which, in view of its moderate dimensions, and the position of the American refiners, is hardly surprising. In conservative quarters it is expected that the Cuban-American stock will be reduced to probably well below 250,000 tons at the end of 1922, which will compare with the stock of about 1,400,000 tons at the end of 1921. The U.S. and Cuban ports stocks at the end of each year compare as follows:—1921 960,000 tons, 1920 305,000 tons, 1919 88,000 tons.

The European Beet crops are standing generally very well, and given favourable weather over the next four or five weeks, a good yield may be attained. The crop estimates so far put forward vary from 200,000 to 600,000 tons in excess of last year's production, the principal increase being in France and Germany. Possibly the quantity available from Europe for this country will be but little larger than has been received from the 1921-22 crops.

H. H. HANCOCK & Co.

10 & 11, Mincing Lane,
London, E.C. 3,
3-0 p.m., 7th September, 1922.

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

The New American Tariff on Sugar.

With much more expedition than was anticipated a short while ago, the American House of Congress composed their differences over the Tariff Bill, and on September 22nd last President HARDING signed the document and brought it into law.

The Smoot rate did not get carried ; compromise was the order of the day in the case of sugar, and whereas the old emergency rate on 96° test sugar was 1·60 cents on Cuban and 2 cents on full duty sugars, and the Smoot proposals were for 1·84 and 2·30 cents respectively, the final decision of the Congressional Committee was for 1·7648 and 2·206 cents respectively per lb. Taking the dollar at par, this means that Cuban raw sugars will now pay 8s. 3d. per cwt. and other full duty raw sugars 9s. 5½d. per cwt.[1] on importation in the United States, a liberal enough degree of protection for the domestic sugar industries, it will be admitted.

In the language of the Sugar Schedule for the Tariff Bill sugars of all classes not above 75° are to be taxed "1·24 cents per lb. and for each additional sugar degree shown by the polariscopic test forty-six one-thousandths of 1 cent per lb. additional and fractions of a degree in proportion."

This new tariff has been the best part of two years in the making. In 1921 the House of Representatives adopted the old emergency tariff as the one to be incorporated in the permanent law. During last winter the Senate Finance Committee had the figures before them and passed the rates on sugar unchanged. But when the Senate itself came to consider the Bill last August, the national interests would seem to have been subordinated to political ones and certain parties in the Senate, chiefly those representing middle Western States (whence the President himself comes) worked up support for a much higher tariff all round, sugar included. It would appear that sugar was one of the few items on which a compromise was arrived at to fix a figure below the one carried in the Senate; most other items of the tariff were finally fixed at a prohibitive rate that will be bound to have a serious effect on the American import and export trade. The House of Representatives is up for re-election next month and doubtless certain interests in the Republican party consider the increased tariff will improve their prospects at the poll. But we suspect that trade on the Atlantic and Pacific seaboards will not be so enamoured of the new rate of protection. It will so stifle the import trade that it is difficult to see how the export trade on its own part can continue to exist, since in the present state of International finance there is no way of paying for American goods save by sending over goods in return. If these cannot enter owing to a prohibitive tariff, what then? Apparently the United States will tend more and more to trade within its own borders and leave the overseas foreign trade to countries that have a more equitable rate of import duties.

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[1] Or at present rates of exchange, 9s. 3d. and 10s. 6d. respectively.

U.S. Consumption.

The latest news from America encourages the belief that the demand for sugar is on the increase, and that the second half of 1922 will show an augmented consumption as compared with 1921. There was some fear expressed early in the summer lest the large purchases of sugar for domestic purposes merely denoted a replenishment of invisible supplies, and that the demand would then slacken off. But this has not been borne out by recent events; and a good fruit crop in the States has led to a considerable demand for sugar for canning and preserves. All this strengthens the probability that no large surplus if any of sugar will exist at the end of the year, and hence the new crops should everywhere command more remunerative prices than have prevailed the last two years. On another page[1] we reproduce some figures prepared by the Chief of the Foodstuffs Division, Washington, showing the probable course of production and consumption during the next few months.

Australian Sugar Development.

The Queensland sugar industry, with the alternate ups and downs of its economic conditions, is periodically thrust into the limelight, and the references to it in trade journals are becoming more frequent, showing that a crisis is approaching. The present agreement between the Commonwealth Government and the sugar producers, which saved the industry from apparent collapse three years ago, terminates in March next; and its friends and foes have entered the lists as to the terms which should be granted in the new agreement that is shortly to be made. Elsewhere a writer with wide knowledge of Queensland's economic position contributes an interesting and dispassionate summary of some of the vicissitudes through which the sugar industry has passed. He shows clearly the great advantages which the people of Australia derived from it during the years of dear sugar which are in everybody's memory, when they were able to obtain plenty of home-grown sugar while the rest of the world was forced to consider it a luxury almost beyond its limited means. When the pendulum swung over so unexpectedly and the world's price sank to pre-war level if not below it, the local price was slightly higher than elsewhere, and, although the world's price has since somewhat recovered, it is certain that the terms of the new agreement will not be so favourable to the producers as they are at present. Our correspondent analyses the position at some length and discusses the price which the Australian people can afford to pay while the sugar producers will still have a living wage. The last three years have seen considerable improvements in the cost of production, and he enumerates several others which he thinks may still be introduced with advantage, and these deserve attentive study. On the whole, his tone is optimistic and he thinks that the Commonwealth Government has had time to gauge the full value of its home-grown sugar and will be able to arrive at a fair mean as between the claims of the producer and consumer, and this we devoutly hope may be the case. Meantime, there is always a danger in having all one's eggs in one basket, and there are suggestions of a second string being available to Queensland, in its increasing cotton production. While there are many difficulties in the way of establishing this new industry, especially as regards the labour of picking, it is not disputed that the quality of the cotton produced is of a very high class; and, although it would hardly appear to be the best time for launching out this new line, because of the present low price obtainable, all who are interested in the increase in Empire cotton will watch developments with keen attention. For ourselves, we think that cotton and sugar go very well together; so if the various difficulties can be overcome we would not regret the appearance of Queensland as an important cotton growing country. There would appear to be ample room for both industries, and they would tend to stabilize each other and so maintain an even level of prosperity.

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[1] Page 541.

Kelham and Cantley to work in Combination.

In accordance with the working arrangements which have been entered into with the view to the future amalgamation of the Kelham and Cantley sugar beet schemes, it has been arranged for the sugar beet crops of the Kelham growers to be worked at the Cantley beet sugar factory this year. By dealing with the total acreage of beet now being grown in this country (upwards of 8000 acres) at one factory, so that it can work at its full capacity, it is hoped to secure the lowest economic cost of sugar production for future guidance. In the meantime, proposals for extending and improving the Kelham beet sugar factory are under consideration, with the same object in view for future seasons. The Beet Contracts Department of Home Grown Sugar Ltd. (Kelham) has been placed at the disposal of the English Beet Sugar Corporation, Ltd. (Cantley), for the present campaign, and Mr. ALFRED WOOD, F.C.A., the Secretary of Home Grown Sugar, Ltd. has agreed to act as the Assistant Secretary of the English Beet Sugar Corporation, Ltd. It is the intention of both Companies that Mr. WOOD shall be appointed to be the Secretary of the new Company when the proposed amalgamation has been effected. A Growers' Representative has been appointed by the British Sugar Beet Growers' Society, with the approval of the National Farmers' Union, to represent the interests of over 1300 growers of sugar beet this year, in checking and certifying weights, tares and sugar contents of the beets delivered to the Cantley sugar factory, which latter commenced to manufacture sugar during the first week of October, thus making an early start with the "Campaign." This safeguard to the grower was provided for in the beet contract offered by the two Sugar Companies who are working under a joint arrangement.

Sugar and the Teeth.

Speaking at a gathering of grocers recently, Sir JAMES CRIGHTON-BROWNE, the well-known physician, took occasion to combat the notion fostered at a recent dental conference that sugar was injurious to the teeth, and suggested that they should leave sugar out of the controversy with regard to dental decay. He said that a special and highly competent committee had been lately appointed by the Medical Research Council to investigate this subject of the decay of teeth, and in the meantime Sir JAMES reminded the dentists that sugar perhaps more than any other article of food tended to promote the flow of saliva, and it would not be denied that free washing by the salivary fluid conduced more than anything else to the cleansing and preservation of the teeth. Sugar in moderation also promoted the flow of gastric juice and so aided digestion. When he was in Jamaica he examined the teeth of the children and found that they had not a trace of decay, being in fact as perfect and regular as it was possible to imagine; and yet the mouths of those children were never free from sugar since they were sucking sugar cane all day. Foods were important to physical development and amongst these sugar was not the least. He thought it a very significant fact that in the different races of mankind there was a correlation between physical development and the amount of sugar consumed. Thus of all the forces engaged in the Great War the Australians were physically the finest, and they consumed more sugar than any other race. Other big sugar eaters were the Danes (a fine race physically), the United Kingdom, and the United States, while at the other end of the scale stood Spain and Italy who were small eaters and were not so well grown as the other races cited.

Such dentists as have made comments on the above speech seem however to lay more emphasis on the necessity of cleansing the mouth and teeth after partaking of food (sugar included), than on any inherent tendency of sugar to cause decay. In the circumstances, one would opine that regular and correct cleansing of the teeth would neutralize this possibility, and so leave the subject free to follow his own particular bent for sugar to the benefit of his physical development.

Kenya as a Sugar Producer.

According to a communication to the *Times Trade Supplement* from its Nairobi correspondent, the Victoria Nyanza Sugar Company, after operations covering a period of two years, has reached the point of production and announces its ability to supply the whole of the demands of the country in every grade of refined white sugar by the beginning of October. The enterprise is controlled by an Australian, who has erected a large modern factory and planted over 1000 acres of cane in the centre of a sugar-growing area near Lake Victoria, where he has demonstrated the possibilities of development without protection or other State aids, and has set Kenya producers a sterling example of the efficacy of consistent application to a carefully prepared scheme. Meanwhile the Kenya Economic Committee has recommended reduced rail rates to encourage an export trade in jaggery. It is noteworthy, however, that a trial consignment of this brown sugar, when placed on the Bombay market, failed to produce the cost of the sea freight from Mombasa, and the quality of the local produce is at the moment greatly inferior to the light brown friable jaggery produced in India, and even to the brown sugar manufactured by natives in the coast areas of Tanganyika. There is said to be considerable room for improvement in the methods of manufacture of the Kenya article.

Sugar Production in India.

The production of sugar in India by modern methods (as contrasted with the gur industry) is the subject of a short Note lately issued by the Imperial Department of Agriculture in India at Pusa. From this we learn that during the 1921-22 season eighteen factories made sugar direct from cane. Nine of these are situated in the Province of Bihar and Orissa, six in the United Provinces, one in Assam, and two in Madras. The total amount of sugar worked up direct from the cane by these modern factories amounted to 753,638 maunds or 27,634 tons, as compared with 24,541 tons in the previous season. This is of course but a trifling proportion of the "sugar" produced in India annually; but it shows the real position of India as a sugar producer in the modern sense.

The major proportion of this sugar production is from North Bihar, where roughly speaking cane from an area of over 30,000 acres was put through the factories and produced 524,677 maunds of sugar. Although the United Provinces have the largest percentage of the total area under cane in India, yet the production of refined sugar by modern methods in these provinces fell during the year by nearly 10,000 maunds. The amount was 146,910 maunds. There was however an improvement elsewhere in the supply of cane which resulted in the Indian factories as a whole getting more cane from the growers than in the previous season (10,759,636 maunds as compared with 9,731,415 maunds) so the total production of sugar as stated above was an increase on the previous year. A slight improvement was also noticeable in the efficiency of the factories, a not unnatural result considering that many factories in Northern India which made good profits during the wartime and afterwards, have made extensions and improvements in their milling and boiling capacity.

It should be pointed out that the above figures do not include any of the sugar produced by melting gur or rab in modern refineries, the statistics of which it is hoped to publish separately in due course.

Stone for Anti-Friction Bearings.

One would have supposed that the stone age was irretrievably a feature of the past, but it has been left to a modern German engineer to devise a new form of anti-friction bearing for shafting, etc., in which stone bushes are fitted. These bearings consist of white metal in which special stones are embedded, the pressure of the shafting being mostly taken up by the stones, the white metal merely serving to keep them in position. These stones (according to the *Times*) consist of a variety of limestone which, being rather porous, has the property of taking up a certain quantity of oil. The stone is harder than bronze and anti-friction bearing metal, but softer than the metal used for shafting, which latter becomes polished like a mirror without being ground away.

In making the Beusch bearings—as they are called—a mould is formed consisting of the ring of the bearing and an inner core, the intermediate space receiving the stones. Before the liquid white metal is run in, the mould and stones must be heated to about 400° C or about half the temperature of casting. After cooling, the bearing must be turned to the required diameter, for which purpose a diamond in a turning lathe is best, as steel even if well hardened is too soft; moreover with the diamond an absolutely uniform cylindrical section can be ensured.

The life of this bearing is said to be several times greater than bearings of the normal form using the same anti-friction metal. Trials on the Leipzig tramways have shown that they will run 45,000 miles, whereas the normal life of similar bearings without stones is 6000 or 7000 miles. The metal used was composed of 5 per cent. of tin, 80 per cent. of lead, and 15 per cent. of antimony. For heavy railway wagons 4 or 5 per cent. of copper should be present, in order to allow a higher specific pressure, and to avoid deformation by means of which the stones might be loosened.

The Mirrlees Watson Co., Ltd., of Glasgow, have received from the Sena Sugar Estates Ltd., an order for a complete new factory to grind 1200 tons of cane per day, designed to make very high quality white sugar and, when required, refining sugars. This will be erected on the firm's Zambesi estates, in Portuguese East Africa.

Fifty Years Ago.

From the "Sugar Cane," October, 1872.

Fifty years ago in Demerara the concentration of the juice to the state of syrup was always effected in the so-called Jamaica train, which used naked fire as the heating medium. In this issue of our predecessor, an anonymous article appeared setting forth the advantages and disadvantages of multiple effect evaporation, which was already in use in the French colonies, in Mauritius and in Egypt, as well as in some of the factories in Cuba; and some of the ideas of those days in regard to this development may be gathered from the following excerpt: "Though the triple effet has the advantages of economy in fuel and water, and of evaporating at a low temperature, it has yet some disadvantages. Where it is employed, the whole machinery is of necessity most costly; char filters, char kilns, and a separate vacuum pan being required, in addition to the ordinary crushing and defecating apparatus, and the triple effet itself. Much labour is required, and then although it evaporates at a comparatively low temperature, it yet keeps the cane juice for a long time exposed to heat, and though the heat employed is moderate, it is yet sufficient to do injury to such an unstable compound as cane juice. . . . ."

At this time the beet sugar industry was being founded in America; and Dr. C. A. Goessmann gave an account of the early attempts dating back to 1830 to grow beets containing a fair amount of sugar. These were conducted in Illinois, Wisconsin, and California; and generally speaking the results recorded by this writer were failures on account of the use of inferior or at any rate of unsuitable seed. In order to encourage the new industry, the State of Illinois passed a law exempting from taxation all machinery that might be used in beet sugar manufacture; while the States cf New York and Massachusetts exempted from taxation the capital that might be engaged in the enterprise.

The report of a Commission from Antigua appointed to enquire into the working of the central factory system which had been established in Martinique and Guadeloupe was here reproduced. It is of a little interest to note that in the two largest factories, operating according to the system of manufacture then considered the best practice, the juice from the mill after being strained was treated with bisulphite of lime, elevated by a *monte-jus* to clarifiers, where it was tempered with lime and heated, gravitated down animal charcoal filters, and passed through the triple effect and the pans, the massecuite obtained being cured in centrifugals. Ordinarily, the molasses from this first strike was boiled up with the evaporator syrup of the next day, though when it was very "gummy" it was boiled separately, and allowed to crystallize in tanks, thus giving a second sugar, the molasses from which was considered final and pumped to the distillery. In 1871 some 5325 tons of sugar were obtained from 68,745 tons of cane, that is 6·24 and 1·50 per cent. of the first and second sugar, an 8 per cent. yield being generally expected.

Duboscq had stated in his communication referred to last month[1] that the *idea* of the new polarizer had originated with Prof. John H. Jellett, of Dublin. In this number of the *Sugar Cane*, a letter was published from Prof. Jellett taking exception to the suggestion that his prism was nothing more than an idea. It had been constructed by Bryson of Edinburgh in 1860, and actually used in a "saccharometer" exhibited before the Royal Irish Academy in 1863. Later another model was constructed by Spencer & Son, of Dublin, and a description of it appeared in a well-known treatise.[2]

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[1] *I.S.J.*, 1922, 455.

[2] "Wines," by Thudichum and Dupré. Pages 240-247.

The Cuban 1921-22 Sugar Crop.

(From a Correspondent.)

The Cuban sugar crop for 1921-22 is now practically over, only three factories at the time of writing being still at work. The country has again demonstrated its wonderful producing power, and according to Ports Receipts over 3,600,000 tons have been delivered to the warehouses for export.

The following comparison of the country's production, by provinces, for the past three years will be interesting. The figures are given to the nearest "hundreds."

PROVINCE.	BAGS OF 325 LBS. EACH.[1] 1920.	 1921.	 1922.
Pinar del Rio	752,000	802,500	837,300
Habana	2,411,800	2,979,300	2,146,100
Matanzas	4,409,000	5,102,300	3,475,600
Santa Clara	6,627,300	6,654,100	5,813,800
Camaguey	5,841,000	5,613,000	6,559,000
Oriente	5,932,000	6,487,300	9,091,900
Total bags	25,973,100	27,548,500	27,923,700
Total tons	3,935,500	3,922,200	3,989,100

These figures for 1922 certainly show a wonderful and unexpected production in face of the fact that money conditions were extremely tight, and a large number of factories were hard put to finance their operations. While very close on 4,000,000 tons of sugar have been produced, or will be reached within the next few weeks, a large amount of cane has been left standing in the fields, which shows that cane for over 4,000,000 tons was grown. This standing cane will allow an early start with the next crop, and again, if weather conditions are favourable, Cuba will produce another big output.

The following table shows the varying capacity of the factories; of the 188, nine are in the province of Pinar del Rio; 18 in the province of Habana; 31 in Matanzas; 59 in Santa Clara; 27 in Camaguey; and 44 in Oriente. It will be seen that the vast majority of these factories do not exceed an output of 25,000 tons, and 88 of them are within the 15,000 ton limit.

NUMBER OF FACTORIES.	OUTPUT IN TONS.
18	up to 5,000 tons
32	from 5,001 ,, 10,000
38	,, 10,001 ,, 15,000
32	,, 15,001 ,, 20,000
20	,, 20,001 ,, 25,000
11	,, 25,001 ,, 30,000
6	,, 30,001 ,, 35,000
10	,, 35,001 ,, 40,000
4	,, 40,001 ,, 45,000
4	,, 45,001 ,, 50,000

NUMBER OF FACTORIES.	OUTPUT IN TONS.
3	from 50,001 to 55,000 tons
3	,, 55,001 ,, 60,000 ,,
2	,, 60,001 ,, 65,000 ,,
0	,, 65,001 ,, 70,000 ,,
0	,, 70,001 ,, 75,000 ,,
0	,, 75,001 ,, 80,000 ,,
1	,, 80,001 ,, 85,000 ,,
3	,, 95,001 ,, 100,000 ,,
1	,, 100,000 and upwards.
188	

The factory making the largest output this year is Central "Delicias," in the province of Oriente. This factory passed the millionth bag mark and is still grinding. It will probably make about 170,000 tons before closing down for the crop. This enormous output for one factory establishes a world's record in the production of raw sugar, and shows what factories can do when run at full capacity during grinding operations and under favourable conditions. The smallest output for any one mill was a little over 1000 tons. So there are factories with outputs ranging from 1000 tons to 100,000 tons and over.

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[1] Some factories fill bags of 320 lbs.

Weather conditions over most parts of the country have been favourable for the growing cane. In some districts fields have been neglected, but taking the island as a whole, the cane fields are looking healthy, and if weather conditions continue favourable, another large crop is assured.

THE SUGAR MACHINERY TRADE AND CUBA.

In surveying the present position of the sugar machinery trade in relation to Cuba at the present time, it is necessary to call to mind the state of that trade for the past few years, or say from 1916 onwards. In the year 1916 the price of sugar rose to figures varying from four cents to five cents per lb. in warehouses at the seaports. This allowed for big profits on all well-managed plantations and factories. In 1917 the ruling price was again around those figures, and during the latter part of the year rose yet higher. It was then firmly believed that sugar would not only maintain a high price, but never again fall back to the figures ruling before the war. It was an accepted belief that the selling price of sugar was to be maintained at this higher level.

During 1918 and 1919 the selling price was fixed by Presidential Decree. The Allies, who about this time were calling for sugar, looked to Cuba to produce the quantity necessary. Banks and financial houses were encouraged to support the industry, and for a time endless money was flowing towards Cuba. With such encouragement, the obtaining of loans for the production of sugar was an easy matter. Forests were felled and cleared to plant more cane; sugar machinery of all descriptions was rushed to Cuba, and most of it on long term notes. New factories were erected, existing ones were doubled, and immense quantities of equipment was brought into the country.

This state of affairs continued in all its feverishness till the break in prices took place about the middle of 1920; almost simultaneously a moratorium was decreed.

This contretemps found the country flooded with machinery bought at high prices to be paid for during the succeeding crops with sugar selling also at high prices. The great slump however made it absolutely impossible for buyers of the sugar machinery to meet their obligations, and, in plain language, a large number of the factories were immediately thrown into a condition equivalent to bankruptcy.

In these circumstances, there was nothing left for the manufacturers of the machinery to do but accept the situation, and extend their terms in accordance with the altered condition of the times.

This they have been able to do in many cases. In others extension of terms on anything like reasonable security was impossible, and they were left with the machinery on their hands. That is to say, many sugar machinery manufacturers were left with much machinery lying idle in Cuba. In addition a great deal of machinery was either in progress of manufacture, or manufactured but not yetshipped when the crash took place. Therefore, at the end of August, 1920, large quantities of sugar machinery were in progress of manufacture, manufactured and ready for shipping, or already shipped or at its destination; and as the purchasers could not meet their obligations, that machinery has remained the property of the manufacturers.

Naturally in order to dispose of this stock, heavy sacrifices had to be made. But factory owners were frequently not in a position to buy even at a sacrifice, and even to-day they are not able to buy freely. So that machinery has been on offer since the end of 1920 at much under its then cost of production, and under the cost of production of to-day.

That being the case one can readily see there has been little or no field for other sugar machinery manufacturers to do bona fide trade in Cuba while that abnormal condition persisted.

This naturally raises the question : When will most of that surplus machinery be disposed of ?

At present it is being got rid of little by little. There are no big purchases being made. The factories are buying only that which is absolutely necessary to carry themselves on with their crops at the present time, but the day is not far distant when the field will be again opened up to healthy competition, and much new machinery will be bought. Although sugar is again at a good price, all factories are continuing to get along on the least expenditure possible, with a view to liquidating their indebtness as soon as possible, and place themselves once again on a sound basis. With good prices for sugar for the coming crop, much headway will be made, the financial burden on the factories will be greatly relieved, and the field for the sale of new machinery greatly broadened.

As previously stated, little or nothing has been done towards the betterment of the factories for the past two years, and as that condition cannot go on indefinitely, betterments and replacements must begin to take place soon. With the start up of the new crop, factory owners will be formulating their plans for the following year, and if sugar prices hold good, it is reasonable to believe that a considerable amount of machinery orders will be placed in time for the crop of 1923-24. Thereafter the field will broaden rapidly and soon get back to normal.

Hence I think we can now safely conclude that the surplus machinery is nearly all disposed of, which clears the way for new manufactures; that by the end of the coming crop the financial burdens on the sugar properties will be so relieved that replacements and betterments will be taken in hand ; that the wear and tear for the past two years must be made good ; and that, in short, the situation to-day points to an early recovery of the sugar machinery trade with Cuba.

British sugar machinery manufacturers will then do well to keep in touch with conditions in Cuba, and have their representatives on the spot, so that they may get a fair share of the trade that is about to revive in the near future. About three years ago, in a previous article,[1] we discussed in a very broad way the representation British firms should have in Cuba. We reiterate here that nothing less than the enterprise called for in that article will do if a fair share of the trade is to be expected. We trust, nevertheless, to see British firms take opportunity by the forelock, send their representatives into the field and once more get their fair share of the Cuban sugar machinery trade.

An order for three 20 ft. 4-compartment Dorr clarifiers for use in the treatment of the total mixed juices according to the Petree process has been placed with Petree & Dorr Engineers, Inc., of New York, by the Baragua Sugar Co., Cuba.

It is of interest to note that the Fulton Iron Works Co. is open to cater for the requirements of the small sugar manufacturer as well as for those of his colleague crushing many hundreds of tons of cane per day. This firm recently installed at Salvador, Central America, a plant grinding only 6 tons per hour, consisting of a crusher and three 3-roller mills, 18 in. by 42 in., the top rolls being hydraulically operated, and the mill worked by an 18 in. by 42 in. Corliss engine through solid compound gearing. This installation, therefore, forms a miniature modern milling installation, constructed to stand severe strains.

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[1] *I.S.J.*, 1919, pp. 13-16.

Laboratory Work on White Grub in Porto Rico.[1]

The white grubs of the Porto Rico cane fields consist of two main classes, the Melolonthini or May beetles and the Dynastini or Rhinoceros beetles. A paper on the latter by E. J. SMYTHE recently received notice in this Journal,[2] but, as the damage done by them is far less serious than that of the May beetles, an enquiry was made regarding an earlier paper on these by the same author. This was found to be out of print, but a copy was borrowed,[3] and its contents have proved of such interest that some of the details are here presented. This paper is, however, very long, and in the present article attention will be drawn chiefly to the general, introductory section—the laboratory work which had been accomplished when SMYTHE commenced his work—and the methods adopted by him in his researches. As will be seen, these are very interesting and throw a good deal of light on the natural history of this elusive pest of present day sugar cane fields all over the world. Considering the importance of white grub as a cane pest, and the huge sums of money which have been and are being spent upon its control, we offer no excuse for giving these details, especially as the information digested is of an entirely different character to that obtained from our study of the work on these pests recently referred to in Queensland.[4] The fact is also to be noted that the results of SMYTHE's work are now to a certain extent a closed book, in that this valuable paper is no longer obtainable by those interested in the subject. The results represent the work of four years in the south coast laboratory of Porto Rico, near Guanica Central, and in the heart of the district most seriously infested.

White grub is the general name applied to all the injurious Scarabaeid beetles attacking the sugar cane, either as adults or as larvae. In Porto Rico they prevail chiefly in the drier parts of the island, although different species are known as pests wherever the sugar cane is grown. For various reasons the pest is much more dangerous in the western half of the island, and this was the reason for installing the laboratory where it is.

The conditions in the cane fields, it is pointed out, are ideal for the development of this pest, the cane being planted year after year in solid masses without any rotation. Before 1913 many experiments were carried out, with poison baits, fumigation, deterrent agents against laying the eggs, flooding the ground, killing the beetles and spraying the foliage of their food plants, the introduction of enemies of various kinds, and so forth. The results are described as often having been negative and costly, therefore the author set about obtaining a more accurate knowledge of their life history, the efficiency of the various cultural methods in the island, and the possibility of readjusting the balance of nature by the introduction of suitable parasites. The study of the life history of soil grubs is especially necessary, if only to discover some phase in which controlling methods may be applied, As in Queensland, there are two entirely different propositions, the attention to the adult beetle in the air and to the immature stages in the soil,—eggs, grubs, and pupae: the grubs are the main source of the trouble, and the adults are only attacked in order to reduce their numbers.

The white grubs, known locally as "caculos" or "gusanos blancos," are subterranean and move little from place to place; they are bent and move with difficulty above the ground; their bodies are thick, soft, white and sparsely hairy, with six well developed legs which are not used for walking, a brown chitinous head and powerful mandibles easily capable of tearing vegetable tissues and tunnelling in the earth. They are universal pests, occurring in practically all parts of the world. In the tropics they are perhaps most destructive wherever sugar cane is grown, and have attained great prominence in the cane fields in Porto Rico, Mauritius, Java and Australia. There are a large number of different genera and species to be found in different sugar cane tracts; thus, Ligyrus is a pest in Louisiana, Lepidiota and several others in Australia, Apogonia and four other genera in Java, Anomala and Adoretes in Hawaii, Phytalus in Mauritius and Barbados, Phyllophaga or Lachnosterna in Antigua and St. Kitts, Dyscinetus in British Guiana, 13 species in Cuba, and so on.

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[1] The White Grub injuring sugar cane in Porto Rico: 1. The May beetles or Melolonthids. E. G. SMYTHE. *Journal of the Department of Agriculture of Porto Rico*, Vol. I, No. 2, April, 1917, pp. 47-92, and No. 3, July, 1917, pp. 141-169.

[2] *I.S.J.*, 1922, pp. 362-3.

[3] We are indebted to the kindness of Dr. MARSHALL, Director of the Imperial Bureau of Entomology, for the loan of this copy.

[4] *I.S.J.*, 1922, pp. 423-426.

Because of the underground habit, the study of the life history is one of the most difficult in economic entomology. Outside of Europe very few life cycles were worked out before 1916. In a United States Bulletin referring to Lachnosterna, published in 1913, it is stated that "there is only one published record and only one species has been reared from egg to adult," and similarly, in Australia, not one white grub cycle had been worked out in 1914. In Europe the cycles are long: *Melolontha Melolontha*, the most serious pest, takes three years in France and Southern Germany and four years in Northern Germany to pass through all its stages. From their periodic appearances it was estimated that the life cycle in the United States forms was shorter, but DAVIS, having worked out 18 species of Phyllophaga, found 11 to take three years, 2 three to four years, 3 two to three years, and 1 two years. This length of cycle is quite unusual in the tropics, possibly owing to the absence of winter, and SMYTHE found that the five May beetles in Porto Rico took one year or less each.

The natural enemies of the white grub have received very special attention. In Porto Rico SMYTHE classifies them into three groups: animals and birds, insects mites and worms, and fungi and bacteria. In the first class there are, unfortunately, no small mammals in Porto Rico, and the attempts to introduce them have not been successful; lizards are abundant, but these are too small to tackle the beetles; birds, however, are very useful, and of these the "blackbird" (*Holoquiscalus brachyptera*) is probably the most efficient, although an owl, a small heron, and a cuckoo also do some service. As the result of stomach dissections, the following percentages of beetles and grubs were noted in their contents:—1·61 in the blackbird, 24·4 in the owl, 1·0 in the heron, and 0·5 in the cuckoo. But this in no way represents their general efficiency. In the cane fields 23 blackbirds showed 9·47 per cent. of white grubs and, after a day following the plough, as these birds are accustomed to do, the percentage would be far greater. A bird can take in its own weight of food in 24 hours, and therefore the blackbirds would destroy a very large number when the soil is turned up.

The insect enemies noted constitute nine species, all native: six Scoliids and one Elaterid attacking the grubs, and two Tachinids parasitic on the beetles. Only one of these is at present known to be hyperparasitized, namely, *Campsomeris dorsata* (Scoliid) by an unnamed Chalcidid. As to their efficiency little is known. Only Pyrophorus (the Elaterid) has been fed for long periods in confinement on grubs, and its extreme abundance in the northern and eastern portions of the island is thought possibly to explain in part the little damage done by the May beetle in those sections. The same applies to the two Tachinids, and it is considered that these are likely to be even more efficient. However that may be, the insect enemies of the white grub are obviously quite inefficient in the western part of the island, and this suggested the introduction of exotic parasites. The first efforts were naturally made to obtain these from the United States, where they were better known and where great variations in climate and soil prevail. This work was commenced by VAN DINE and continued by others from 1911 to 1914, and about 2500 specimens were introduced and about 1000 freed, the bulk of them being Tiphia. At the same time VAN DINE introduced various entomogenous fungi, but later on a modified form of the parasitic fungus was found in Porto Rico itself, and several liberations of spores have been attempted with varying results.

The methods of rearing the grubs in captivity adopted by SMYTHE are given in some detail. This was found to be easier than in temperate regions, because of the absence of frosts, the more uniform temperature, and the shorter life cycle, but the danger from moulds and insect attack somewhat nullified this advantage. The first experiments were made with 4 in. jars and glass pots, which had been found useful elsewhere, but these were soon discarded as unsatisfactory, and small seamless tin boxes 2½ to 3 inches across and 1½ in. high were substituted. These smaller receptacles were much more convenient and could be stacked one above another, besides taking up far less space, and with inspections every few days succeeded perfectly. Moisture was added either by changing the earth or adding damp earth at the top. One corn seed was sown in each box to serve as food. If there was too much moisture or food, mites at once appeared and had to be carefully brushed off the grubs. Pieces of sugar cane were found to turn sour and encourage mites. The natural movements of the grubs tended to packing the soil, and this was remedied by working over the surface with a small knife, the grub retreating to the end of its burrow or tunnel and remaining there out of harm's way. To start the experiment the box was filled evenly with moist earth, slightly packed with the hand and a small depression made in the middle, in which to place the grub without covering it. The success of this method was gauged by the fact that emergence of the adult tallied closely with the control experiments made outside in cages, more or less under natural conditions. These cages were 6 × 3 × 3 ft., with 6-10 inches of moist soil in which corn or sugar cane was planted. They were then left alone except for an occasional watering, or replanting when necessary. Phytalus grubs alone of those dealt with in the boxes were unsuccessful, and the life cycle in these was calculated from the control cage experiments.

But to revert to the eggs, difficulty was at first experienced in getting these. Ultimately, small glass jars four inches across and six inches high were found satisfactory. About two inches of moist soil was placed in the bottom of these jars, the soil having been previously sifted to a smaller size than the eggs, so that the latter were easily obtained afterwards by again sifting. Upon the surface of the soil two or three small strips of moistened plantain leaf were pressed down and the beetles placed inside. It was not found necessary to put the beetles in in pairs, for in no case was copulation observed in captivity. The collected eggs were best hatched in closed petri dishes, with damp earth carefully sterilized and kept at a uniform temperature. When the grubs were hatched they were transferred separately to the tin boxes, each one being placed in the small depression mentioned above. The minute grubs soon disappeared in the soil and, in due course, formed their burrows below the surface. No food was given at first, for the grubs were found only to feed on the humus in the soil till they had passed the first moult.

Before pupating, the grub becomes soft and flabby and lies inert on its back in the tunnel. Prior to the change the grub makes the interior hard and smooth and slightly broadens and enlarges the cavity. During pupation the soil must be kept moist and a special look out kept for mites which must be removed. In nature the grubs before entering the pupal stage burrow down something like a foot, and this is supposed to have, as its objects, uniformity of temperature, withdrawal from disturbing influences and avoidance of rootlets which quickly fill the cavity with a dense felt-like mass. After the change takes place the beetle is left alone for several days till it darkens in colour; then the box lid is removed and a piece of blotting paper pressed on the surface and the whole turned out and sunk in several inches of soil at the bottom of jars or pots. The beetle emerges in due course, and it is surprising how many of them are successfully reared. It is obvious that the grubs need constant attention and it strikes one as rather curious that such tender creatures prove so amenable to handling.

The remainder of the paper deals with the five species found on Porto Rico canes. These are *Phyllophaga vandinei*, *portoricensis*, *guanicana*, and *citri* and *Phytalus insularis*, of which the first is far the worst sugar cane pest in the island, although geographically it is confined to the western half. It is recorded that near Guanica it has often caused whole cane fields to fall prone and turn sour in a week after the damage has first become evident, and besides costing hundreds of dollars in collecting has made ratoons impossible. Hundreds of bushels of beetles caught by lantern and grubs collected in the ploughed fields are destroyed or fed to hogs each season. This species naturally has received most attention and the full description of the laboratory experiments and observations given will be of interest to all planters troubled with white grub, but cannot be compressed into the present article.

C. A. B.

A White Australian Sugar Industry.

Milestones along the Road of Development.

By T. D. CHATAWAY, ex-Senator for Queensland.

The Australian sugar industry is about to pass another milestone in its journey towards ultimate safety both as an industry and as an exemplification of the possibility of a tropical industry being carried on without the employment of cheap labour—coloured or otherwise. It was started by pioneers at a time when there was practically no labour of any sort, and for twenty years reliance had to be chiefly placed upon the employment of South Sea Islanders and other coloured labour introduced from abroad. Then came the reform of the labour trade, the restriction of the work in which islanders could be employed, and the advent of white labour, which was paid high wages—as wages were measured in the eighties. The next milestone was the subdivision of large estates, and the placing on the land of working farmers—mostly white. This was rapidly followed by the creation of central or co-operative raw sugar mills, and by the beginning of the nineties the cost of growing cane had been reduced by at least 40 per cent., and the small proprietary mills were rapidly closing down. With the advent of the Commonwealth the comparatively few islanders lost their employment; white cane-cutters took over the harvesting operations, and the gradual organization of these manual labourers into a part of the gigantic Australian Workers Union commenced. The milestone the industry is at present passing is that which marks the struggle between organized labour, in Parliament and out of it, and the actual industry as a whole. There are side issues, namely, whether the millers or the refiners receive more than their fair share, or whether the wholesale merchants and the grocers are overpaid, but the chief issue is as to whether organized white labour will consent to have its wages so adjusted that the industry can carry on, or whether the industry itself can lessen the quantity of labour employed or make it more efficient by the application of machinery, and general internal reform.

Probably the worst blow struck at the industry was in the earlier days of the war when the Labour Governments, of Queensland and the Commonwealth, commandeered the output in order to supply it to the consumers at less than there was every prospect of their having to pay. The Industry had been making steady progress, chiefly in the matter of enlarging the sugar mills, the application of mechanical improvements, and the substitution of 1000 miles of 2 ft. tramways to take the place of carts, horses and drivers, and their picturesque wastefulness. The Labour Governments' action struck the first blow at the white tropical industry. It fixed the retail price of sugar at a figure which made production unprofitable. Between 1914-15 and 1919-20, when the protection of the Commonwealth Nationalist Government was sought against the State of Queensland, the area under cane fell from 172,636 acres to 159,037 or by 13,599 acres, equivalent to an output of 27,000 tons of sugar. White labour was demanding and getting remunerations in accordance with the increasing cost of living, and the producers were arbitrarily tied down to selling their product at pre-war rates. It was at the end of March 1920 that the Commonwealth agreement with refiners, millers, growers and labour unions was entered into for three years. It was based on the assumption that the mill should receive £30 6s. 8d. for raw sugar of 94 per cent. analysis; the growers, their share as fixed by State Government price fixing boards; the refiners, a fixed charge for freight from the mills to the refinery, for actual refining and distribution; and the workers' unions, the wages awarded in the State Industrial court. There was nothing in the agreement about the retail price of sugar, and the period of the agreement was for the three years, which end next March.

Obviously if the local production of sugar were insufficient during this agreement it was necessary for the Commonwealth to import sugar on its own account, seeing that it would not have been possible for the Government to guarantee a fixed price to Australian producers unless it also controlled the importation and distribution of sugar not locally made. It fixed the retail price of all sugar at 6d. per lb., even at a time when it should have been 1s. and even more. In brief the Government stabilized the retail prices of sugar as well as those of raw sugar, and the result of the whole transaction has been the source of much controversy since sugar values collapsed a year or so ago. It is worth noting, however, that at no time during the agreement has the wholesale price of sugar materially exceeded that of 1902 plus the increased cost arrived at by the Commonwealth statistician in 1920.

The Minister for Trade and Customs, himself a politician of anti-control convictions, has now placed before Parliament a statement covering the whole of the seven years period during which the Commomwealth Government took control. There is another year yet to run. Briefly his figures show that the purchases by the Control were as under:—

Where Purchased.	Amount. Tons.	Price per Ton. £	s.	d.
Abroad	466,787	40	3	4
In Australia	1,530,391	23	14	9
Total and Average	1,997,178	27	11	6

I have no desire to defend Government interference in ordinary business, but it is clear, especially when compared with the results in Britain, where there was no local production, that the Australian industry at a crisis proved a great stand-by for the whole community. To-day there is still a deficit of some £255,000, but this will soon be wiped off. In the United Kingdom, I understand, the loss of some £24,500,000 was simply charged up to ordinary expenditure. If we only take the post-war cost to the consumer there is assuredly no reason for him to complain.

I have no desire, however to unduly emphasize the results of Government control. It was inevitable. The Commonwealth could not allow producers, to rush prices up to £100 a ton or more, as in neutral countries such as Cuba and Java, nor could it restrict export by the producers, while permitting importers a free hand. Consequently it took over the entire control. The Government had already seen that every increase in the price of raw sugar was immediately followed by increased demands on the part of labour, so the last order took the form of an agreement binding all concerned with the production and refining of cane, and sugar—whether so-called capitalists or workers—to peaceably carry on. With this there has been as much peace as might reasonably be expected in an industry scattered along more than a thousand miles of coast-line and in which the employers count some 5000 and employees about three times that number.

But the Prime Minister, early in 1920, gave a deputation from the sugar industry a very definite charge. If they hoped for further consideration they must so increase their production that they would be able to supply all Australia. He did not press the necessity of improving their methods of carrying on their business. He left that to them, and there can be no question that the brains of the industry were not slow to grasp their responsibility in the matter. Given even a moderate share in the world-wide profits of sugar, they set forth to make the most of the opportunity. The sugar producers claim that they have more than obeyed the behest of the Prime Minister, and they also argue that no government has a right to suddenly take control of an industry, fix prices, regulate distribution, and thereby create new conditions and then suddenly drop the whole organisation into the melting pot of de-control. It is an admitted fact that even a bad government is better than no government at all; and it is doubly true that the loss of any control without a substitute is a synonym for anarchy. It is for this reason that the sugar producers desire further Commonwealth control during the period of reorganization. They dread the possibility of further experimental commandeering, and seek to strengthen their internal organization.

The idea that the producers and mill managers will become slack, careless, and enfeebled under the agreement conditions has been fully dispelled. The following figures are instructive. The first decade marks the last years of coloured labour and the accompanying excise and bounty systems; the next ten years, progress entirely with white labour, though during the last four years of the decade the industry was hampered by the commandeering of the crop at an unwarranted low price; the following two years were ones of exceptional seasonal adversity; the last year (1921) was the first of good crop conditions and the increased price for raw sugar combined:—

	TONS CANE PER ACRE.	TONS SUGAR PER ACRE.	TONS CANE PER TON SUGAR.
1899 to 1908	14·76	1·60	9·20
1909 to 1918	17·37	1·99	8·68
1919	14·83	1·91	7·76
1920	15·03	1·88	8·0
1921	17·54	2·17	8·05

The average yield per acre in actual cane is little guide except to the seasons, and in a lesser degree the increasing use of fertilizers, and the same may be said of the yield of sugar per acre, though that with the amount of cane required to produce a ton of sugar is a safe barometer of our mill work. The current year, 1922, is expected to give results very similar to those in 1921, though it may prove that a spell of dry weather in some of the districts will, while reducing the average weight of cane per acre, result in a more satisfactory figure under the third headline in the above table.

More important, however, to the present discussion is the fact that the sugar this year will be produced more cheaply. Stimulated by the prospect of freedom from unprofitable commandeering, at least for a year or so more, large sums of money have been spent in bringing sugar mills up to a far greater capacity than was dreamt of a few years ago. It has become an axiom that no raw sugar mill, with its complementary tramway service, can be laid down under £500,000, and the capacity to be reckoned upon must not be less than 15,000 tons. I have before me a list of the 33 chief raw sugar mills in Queensland, with an average output last year of 8000 tons of sugar. Their capacity is over 10,000 tons each, and no less than a dozen of them may be relied upon to reach the 15,000 ton output in a season of steady cane supply. According to a statement by the Prime Minister, these mills, after paying for the cane, have about £11 6s. 8d. to pay for labour, supplies and interest on capital. Mr. HUGHES calculates that the mill pays between 60 and 70 per cent. of its earnings in labour, so we may conclude that at least 66 per cent. goes in labour and casual expenses. If this is not too optimistic a calculation a mill would still have left £3 15s. per ton of sugar towards paying interest on capital. This it is clear would give a return of 10 per cent. on the capital required to erect a mill of the necessary economic capacity of 15,000 tons. Also, according to Mr. HUGHES, of the £19 received by the cane-growers 75 per cent. or £14 5s. goes to pay labour, leaving a balance or gross profit of £4 15s. per ton of sugar for the farmer. Accepting the average of 8 tons of cane to the ton of sugar, the net result to the grower is only 12s. per ton of cane.

There are nearly 5000 cane-growers, and their average crop harvested in any one year does not exceed 40 acres. If we accept £31 15s.[1] as the improved value of a cane farm per acre, and the average size of the farm about 120 acres, the 40 acres of cultivation have to pay interest on a capital value of £3810. The assumed size of the farm is not too much, seeing that for the ten years 1911-20 the proportion of acreage harvested to that under cultivation to cane averaged 61 per cent, and the farmer must have a certain amount of land available for his homestead, and for grazing purposes. At six per cent. the farmer will require £228 as legitimate interest on his capital. At 12s., as above, for 17·5 tons of cane to the acre, the farmer has roughly £420 from his 40 acres, and after deducting interest on capital a balance of £192 as wages for his own work, maintenance for his wife and family, depreciation, and sundries. Practically therefore he is working for less than £4 a week, and taking all the risks. In Northern Queensland the ordinary field labourer earns as much, and he takes no risks. Mr. JUSTICE POWERS, in the Commonwealth Arbitration Court, allowing 25 per cent. time lost in travelling by shearers, has fixed their wages at a rate which will yield them from £8 per week upwards according to their skill.

It is clear therefore that neither the owners of the raw sugar mills nor the thousands of white cane-farmers are earning exorbitant profits. If, therefore, there is room for further economy, it must come first of all in the fields. While I can only repeat the argument of my last article that the chief economy lies in the finding of a machine or appliance to greatly reduce the cost of harvesting, there is a satisfactory development in the reduction of the cost of other field work. The tractor is at last coming into its own. A report by an official of the Queensland Bureau of Experiment Stations is highly instructive. It is quoted at length in the *Australian Sugar Journal* for July last, but it is sufficient here to say that the use of tractors is becoming general. Farmers, who had used them spoke enthusiastically of their value, of the rapidity of the work, and the continuity of work in hot weather, when horses required a spell. Two shifts a day could be worked in the long summer days—a feat impossible with any reasonable number of horses and white men. It is enough to say that the tractor, where used, is more than fulfilling expectations. The question of fuel is still one of the drawbacks. The ideal I voiced in my last article that every mill should supply cheap spirit fuel made from molasses to the neighbouring farmers is now within sight. It is understood that the Commonwealth authorities, who have shown themselves lamentably lacking in imagination, though not in pessimism, are at last prepared to lift the embargo on the manufacture of motor spirit unless the most expensive denaturant is used. The tractor is not only about to reduce the cost of cultivation, but it is going to increase the amount of cultivation (apart from harvesting) which a white farmer can do upon his land. It is reported that young white men are rushing the driving jobs in connexion with tractors, and already the blacksmiths of the small villages throughout the sugar districts are taking on the minor jobs of motor mechanics. It is not difficult to visualize an immense cheapening of the production of sugar by white labour, when the mills are trebled in size and the fields are traversed by tractors to the elimination of the horse, and all he means in the way of feeding, doctoring, shoeing, harness, etc.

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[1] Commonwealth Royal Commission, 1920.

The reform in the fields must go still further. If the cost of cane-cutting machinery is insuperable in the case of the thousands of small farmers, it by no means follows that harvesting companies cannot fill the gap. As I pointed out two years ago, they have done this in the case of hop-picking in Tasmania, sheep shearing in the pastoral districts, and there is no reason why the same organization with white labour is impossible in the cane sugar areas. It is merely a question of time and necessity. The time the Australian producers hope to secure with a renewal of the current agreement (even with modified conditions); the necessity faces them in the fact that Australia will not agree to a permanent Government control in any first-class industry. To-day the introduction of petrol engines has reached the stage when the long lines of cane-carrying tram trucks are being hauled, in one district at least, by internal combustion engines. One needs little imagination to visualize what will be the economy when there is no cutting of fuel for wood fires, and in the place of this expense comes the actual using of molasses (converted into industrial alcohol) which at present is wasted. The economic effect is the same as that secured politically by the change of a man's opinions. It counts as two—obviating a cost on one side and adding to earnings on the other. The point, however, is very obvious. The Australian industry is still standing still in relation to loading operations in the fields. The manual cane-cutters are paid a price which includes their loading cane on the trucks alongside them, but the moment the mechanical cutter is at work, and the cane is lifted from the ground it will never touch the ground again, but be passed into trailers or side trucks for transmission to the factories. It is the fact that no cane-cutting really fulfils its purpose while the mechanism throws the heavy cane, which has been raised from the ground, back on to the ground to be again raised before being loaded on the tramway or railway trucks.

In a contribution to *The International Sugar Journal*, which I was allowed to make last March, I set forth some of the ways in which there could be readjustments of expenses in regard to the industry. The foregoing attempts rather to show that the war conditions did not greatly help towards the development of the industry, except as a temporary "boom." A section of the Australian sugar farmers is comprised of men who have been labourers, and believe in the "three acres and a cow" theory of agricultural development. True to the faith of Labour politics they still assert that while they should get more out of the industry every other human factor in it should get less. They are the men who, for lack of means and imagination, stand in the way of progress, but having many votes they are able to make themselves heard. They cannot afford expensive machinery, and look askance at those who suggest such bodies as harvesting companies; they regard the refiner as their natural enemy, though not one of them has the barest idea of what would happen to the raw sugar mills if there were no refiners. They suspect the raw sugar mills (though often controlled by co-operative companies of farmers like themselves) of profiteering, though to close those mills would be the slaughter of the golden egg-laying geese. I mention these points because there are not wanting many producers all over Australia, and some public men, who are quite prepared to say that the Australian sugar industry is doomed to failure. If it is killed, it will not be killed by the modern worker, but by the very small farmer, who was once a Labour politician.

The retail price of sugar is about to be reduced to 5d. per lb. At almost the same moment a reduction in South Africa has been announced to 4½d. The difference in price is obviously £4 13s. 4d. per ton. There is good reason to believe that the Australian price could easily be reduced to the South African figure, but the Commonwealth Government wants to have a political card up its sleeve. Now, South Africa employs Kaffir, Indian, and other forms of coloured labour; Australia employs none. There may be a few scattered men of colour amongst the cane-cutters, but they are also to be found amongst the seamen, the shearers and the waterside workers of the most temperate parts of Australia. If the extra cost of white labour over black is fairly reckoned at £4 13s. 4d. per ton the prospects of the Australian industry are excellent, but there is no reason to believe that given the reforms to which I have had occasion to refer during the last two or three years, the margin will not only be wiped out but quite possibly established on the other side of the statement of profit and loss.

In addition to the mills of the Hawaiian Commercial & Sugar Co., and the Maui Agricultural Co. (referred to August), Central Soledad, Cuba, is to be installed for working with the Petree process during the coming season. When these installations are complete, the Petree process will be in operation in every important cane growing country of the world.

In the Philippines so great has been the number of locusts in the cane fields that their presence is deemed as great a calamity as drought, a serious plant disease, or rinderpest. Experimental work,[1] which has been conducted by Capt. CHAS. W. WALTON, U.S. Army, Chief of the Chemical Warfare Service, P.I., shows that as compared with some systems as driving, poisoning with arsenic, or killing with a spray of crude oil or soap solution, chlorine appears to be far more effective, efficient and economical. The greatest objection to chlorine is the fact that if it is used in a valuable crop, it will probably kill the plants in a limited area; but, in some cases, so serious is the infestation that it would be justifiable to kill a small portion of a crop if the death of the insects could be assured.

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[1] *Sugar News*, 1922, 3, No. 7, 307.

Significance of Presence of Oxalates in Evaporator Incrustations.

Also a new sensitive colour test for oxalic acid.

By CH. MÜLLER, Pharmacie Nationale, Alexandria, Egypt.

A relationship exists between the regularity of the work of evaporation from the point of view of the quantity of water eliminated in each body (expressed as a percentage of the total), and the quantitative composition of the incrustations which may be recovered while cleaning the apparatus. The writer believes he has found a relationship between the work of the apparatus and the presence of alkaline earth oxalates.

For example, in the case of two evaporating apparatus, quadruple effects, Cail vertical bodies, the first doubled, heated by exhaust steam, a barometric condenser, the temperature of the water 35° with a maximum of 39°C., the following figures were obtained. These two apparatus, *A* and *B*, operated alternately during 15 days.[1]

	Apparatus A.				*Apparatus B.*			
BODY.	I.	II.	III	IV.	I.	II.	III.	IV.
Water evaporated, per cent. of total eliminated	55·40..	18·00..	13·10..	13·50	49·60..	7·10..	19·40..	23·90
	100				100			
Water evaporated in each body, per cent. by weight of juice entering	43·00..	14·00..	11·00..	10·00	49·00..	9·00..	8·00..	6·00
	78				72			
Silica	3·50..	1·12..	23·42..	49·84	4·95..	4·45..	22·17..	35·12
Calcium phosphate	67·24..	68·28..	51·38..	13·05	30·95..	31·95..	20·84..	3·42
Calcium sulphate	0·88..	0·90..	0·98..	0·58	6·35..	6·25..	5·36..	1·45
Calcium, combined to organic matter	10·02..	2·20..	1·72..	1·28	3·55..	3·60..	15·22..	10·58
Iron and aluminium oxides...	6·16..	5·72..	2·42..	0·95	15·25..	17·25..	6·16..	5·18
Organic matter (loss at red heat)	12·20..	21·78..	20·08..	34·30	38·95..	36·50..	30·25..	44·25
Soluble in acids[2]	84·30..	77·10..	56·50..	15·86	56·00..	58·00..	43·00..	21·00
Soluble in sodium hydroxide[3]	15·70..	22·90..	43·50..	84·14	44·00..	42 00..	57·00..	79·00
Oxalates	much	traces	none	none	much	much	traces	none

In Apparatus *A*, therefore, the work was regular, syrup leaving at 36° Bé. without any crystallization in the interior of the fourth body.

Incrustations were collected from the bodies of the apparatus by scraping, and several analyses were made, oxalates being looked for particularly. The analytical figures stated in the table above were the average of seven analyses made after the material had been dried at 102° C.

It is seen from these analyses that the work in Apparatus *A* was regular in the sense that the proportions of alkaline earth oxides, phosphates, sulphates, etc.. gradually diminished from the first to the fourth body. As to the silica, the contrary was observed.

It is of importance to verify the presence of oxalates in the various incrustations. Identification of this acid, ordinarily rather complicated and uncertain, becomes very easy and conclusive by means of a new colour reaction which the writer has found, and which is described later.

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[1] The only difference being that in Apparatus *A*, vapour was taken from the second body for re-heating the maceration water of the mills, none being taken from Apparatus *B*.

[2] That is, calcium phosphate, sulphate, etc. [3] Silica.

Coming now to the Apparatus *B*, it is seen from the figures in the table above that the second body hardly operated, while all the others were, in consequence, adversely affected. In fact, it evaporated 72 per cent. by weight of the juice, whereas Apparatus *A* evaporated 78 per cent.

Regarding the analyses of the incrustations from Apparatus *B* (also the average of seven analyses), it is seen that those relating to the first and second bodies were almost identical in composition, and in fact corresponded to the work of these bodies, which was absolutely irregular and insufficient.

Hence, the presence of oxalates in the second body may suffice to indicate to the manufacturer the irregular operation of his evaporator; and for the reason that the concentration of the syrup obtained in the second body is insufficient to completely precipitate the oxalates (which are insoluble in concentrated syrup). There should, therefore, only be insignificant traces of these compounds in the incrustations of the second body.

COLOUR TEST FOR OXALIC ACID.

It remains to describe the colour reaction for oxalic acid, one that is very sensitive and absolutely characteristic, as the writer has found after long investigation.

One hundred grms. of the incrustation are freed from sugar by repeatedly washing with boiling water, the absence of sugar being confirmed by the well-known reaction with α-naphthol and sulphuric acid. This done, the incrustation is treated with 300 c.c. of sulphuric acid (1·10), and the liquid filtered, evaporated and made up to 50 c.c.

Ten c.c. of this solution are gently evaporated in a test-tube, almost to dryness, a pinch of resorcinol (pure) is added, and 2 c.c. of sulphuric acid are allowed to run down the walls of the tube, when a green or blue ring forms, which after agitation assumes a magnificent azure blue, this becoming violet after heating. The intensity of this colour is very sensibly proportional to the amount of oxalic acid contained in the assay liquid.

This reaction, the writer believes, is absolutely characteristic of oxalic acid and its salts; and to confirm this he has applied it to the principal organic acids which may or may not occur in plants (using 0·5 grm. of the acid or its salt, a pinch of resorcinol, and 2 c.c. of pure sulphuric acid). On examining the table below, it will be seen that none of these acids gives the blue coloration peculiar to oxalic acid.

Acid.	Colour of ring, after 2 min.	Colour of solution, after agitation.	Colour of solution, after heating.
Oxalic	green or blue	azure blue	violet
Citric	yellow	pale yellow	golden yellow
Tartaric	pink	pale pink	purple
Hydrocyanic	pink	orange	crimson
Salicylic	yellow	light yellow	intense yellow
Formic	red	red	red
Acetic	yellow	yellow	golden yellow
Lactic	orange	golden yellow	red
Pyrogallic	yellow	yellow	bright brown
Tannic	red	dirty red	bright red
Picric	yellow	white (decoloration)	yellow
Benzoic	yellow	yellow	yellow
Valerianic	yellow	yellow	ruby
Thiocyanic	bright red	orange yellow	brown
Malic	orange	straw	vivid red

Rats, and their Suppression on the Sugar Plantation.

By C. L. CLAREMONT, B.Sc., F.I.C.,
late Research Chemist on Rat Destruction, Ministry of Agriculture.

THE RAT PROBLEM.

Of all the mammalian pests the rat and allied rodents easily take first place. Indeed they are perhaps the most successful of all mammals in the struggle for existence, not even excluding man, for despite disease, natural enemies, and persistent persecution, they have succeeded in establishing themselves in almost every part of the inhabited globe.

Aided by extraordinary adaptability to unfavourable and new conditions, the ubiquity and destructiveness of the rat have caused it to become a most serious menace to the human race. It has invaded our homes, factories, and stores, destroyed our food, and spread its diseases among the human race with unabated vigour for hundreds of years.

The problem is no new one. In ancient Egypt cats were sacred animals, largely because of their usefulness for the purpose of suppressing the rat, and the fraternity of "rat-catchers" are descendants of an ancient craft.

Involving as it does crowded urban populations with the consequent importation and storage of food from abroad, the march of human progress has accentuated the problem, two main factors being the greatly increased food supply and harbourage afforded by large storehouses and the increased facilities for movement from place to place provided by shipping. The last factor has been in the past, and is even now, largely responsible for the infestation of those parts of the world which had no native rats, such as Great Britain and America, where the rat has now penetrated to remote districts. Comparatively small islands are usually specially liable to serious trouble once the rat reaches their shores, Mauritius being a case in point where rats do an immense amount of damage on sugar plantations by eating the cane. Indeed in most cane-growing countries throughout the world (though in some more than in others) the rat presents a really serious problem, calling for urgent and concerted action.

Some idea of the cost of the activity of the rat may be gained from various estimates put forward by different investigators. BOELTER,[1] basing his estimate for Great Britain on a rat population of 40,000,000, states that no less a sum than £15,000,000 represents the cost of the rat to this nation. HINTON[2] gives some figures showing that the cost of feeding the rat population for 1918 alone amounted to over £9,000,000. Major KUNHARDT,[3] a member of the Plague Research Committee in India, estimates that over a period of 20 years the total cost of the rat, including losses due to plague, was £828,000,000.

THE RAT FAMILY.

Rats and mice belong to the zoological family *Muridae*, a part of the order *Rodentia* or gnawing animals. We are concerned mainly with the true rats and mice which comprise the genus *Mus*, of the sub-family *Murinae*, and of these, three species only are of importance, for they are the ones which by their adaptability have spread in swarms all over the world. There are of course many other members of the *Murinae* family, but in general they are of local interest only, and in the majority of cases have retained their aboriginal wild habits.

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[1] "The Rat Problem," London, 1909. [2] "Rats and Mice as Enemies of Mankind," London, 1920.
[3] *The Indian Journal of Medical Research*, 1919.

These three are:—

(1) *Mus decumanus*, known indiscriminately as the brown, Norwegian, Hanoverian, or sewer rat;

(2) *Mus rattus*, known also as the black, ship, Indian or old English rat;

(3) *Mus musculus*, the common or house mouse.

Although the first two mentioned are well known they are often confused with each other, mainly due to the fact that colour forms quite the worst means of identification, "brown" rats being far more often black or dark grey, while "black" rats are usually brownish with light bellies. Certain identification can only be arrived at by consideration of several anatomical points such as the shape of the skull and length of the back feet, but as a general guide it may suffice if we point out the salient differences in the form of a table adapted from HINTON.[1]

Feature.	*Mus decumanus.*	*Mus rattus.*
Colour	Usually grey or greyish black.	Usually brown, often quite dark.
Size	Large and clumsy.. ..	Small and elegant.
Muzzle	Blunt	Sharp.
Tail	Short and thick	Long and slender (at least as long as head and body together).
Pads of feet	Relatively small..	Relatively large.
Fur	Soft, few bristles	Soft, but with distinctly bristling appearance.
Teats (in female)..	Normally 12 mammae..	Usually 10 mammae, sometimes 12.
	3 pair on chest	2 pair on chest.
	3 pair on groin ..	3 pair on groin.
Weight of average adult	1½ to 2 lbs...	Rarely exceeds 8 oz.

In habits these two species differ considerably. *Mus decumanus* tunnels out burrows wherever possible, is more cunning and voracious; and, though a good climber, is not so agile as *Mus rattus*. One condition is indispensable for its existence and that is water. They drink frequently, and are fond of swimming; on the other hand *Mus rattus* does not require to drink so often, and will seldom enter water.

Mus decumanus is also a more omnivorous and dirty feeder than *M. rattus*, and though frequenting human houses is actually of the two the more shy and retiring; the latter will, however, live in close proximity to its human host. Both are mainly nocturnal in habit.[2]

SERIOUSNESS OF THE PROBLEM.

Most sugar planters recognize that the problem is serious and urgent. Unfortunately it had received but little official or scientific attention in the United Kingdom at any rate until recently, when the pressure of war conditions caused the British Government to take action. In 1919 the Ministry of Agriculture organized the Rats Branch, Mr. E. C. READ, a well-known authority, being appointed as technical adviser, and the same year the Rats and Mice (Destruction) Act became law. A Rat Research Laboratory was also established under the direction of the writer; considerable progress was made on the purely scientific side, and much attention directed to producing efficient and safe preparations in sufficient variety to deal with the varying difficulties which arise in practical rat destruction. These preparations[1] were issued to and used by Government Departments with considerable success. Unfortunately owing to the necessity for economy the operations of the Research Department were terminated at the close of the last financial year just when the work had begun to yield results of real practical value.

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[1] *Ibid.*

[2] For those requiring further information we can do no better than recommend them to read Hinton's admirable booklet already cited.

(To be continued in two other articles dealing firstly with the nature and habits of kinds of rats, and finally with methods of destruction.)

The Deterioration of White Sugar during Storage in Mauritius.[2]

By H. A. TEMPANY, D.Sc., F.I.C., F.C.S.,
Director of Agriculture, Mauritius.,
and D. D'EMMEREZ DE CHARMOY.,
Assistant Director.

(Continued from Page 467.)

SOME CONSIDERATIONS ON THE PREVENTION OF DETERIORATION.

From what has already been said it seems reasonably clear that while the limits ascribed to the moisture content of sugar at which deterioration is likely to commence according to the factor of safety rule probably hold true, (i.e. that a sugar which shows the value greater than 0·3 for the ratio $W/100-S$ will be liable to deterioration), there is on the other hand no guarantee *a priori* that a sugar which at the time it leaves the factory shows a factor of safety lower than the minimum requirement, will when exposed to a moist atmosphere, not be liable to deterioration; it follows that as a guide to the keeping powers of *vesou* sugars the determination of the factor of safety at the time the sugar is bagged is practically valueless.

Laboratory observations on the other hand shown that other things being equal there is considerable variability in the liability of different marks to deterioration. KOPELOFF and his co-workers[3] have advocated the curing of sugars in closed centrifugals and their washing with a jet of live steam as a process likely to reduce the liability of sugars to deterioration, it being held that this form of treatment will practically sterilise the sugars and further lessen the liability to re-infection by the indraft of air during the curing process. The latter part of the statement is undoubtedly true; but as in practically every factory in Mauritius the method of curing advocated by KOPELOFF is systematically practised, it cannot, in the case of sugars of this type, be held to convey the protection claimed for it.

The effect of this form of curing was investigated by taking three samples of *vesou* sugar from centrifugals in a factory immediately on the completion of the curing process, and plating them out subsequently for enumeration of the organisms present:—

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[1] They are now on the market as the "Klearwell Products"; the agents for which for the sugar industry are The Sugar Manufacturers' Supply Co, Ltd., 2, St. Dunstan's Hill, London, E.C.3 (see advert.), who will be pleased to offer technical advice relating to the rat problem on plantations.

[2] Editorial abridgment of Bulletin No. 24, General Series, published by the Department of Agriculture, Mauritius, May, 1922.

[3] *I.S.J.*, 1920, 591.

No. 1 3 colonies of *Aspergillus*, but no bacteria, per grm. of sugar.
2 2 ,, ,, ,, ,, ,,
3 3 ,, ,, ,, ,, ,,

As the samples in question were taken without any previous warning; and as the condition and process of curing in the particular factory were fairly representative of the average, it is believed that they may be accepted as indicating that when the sugar leaves the centrifugal in Mauritius it is practically sterile.

Re-infection with destructive organisms probably takes place between the time the sugar leaves the centrifugal and the time it is bagged; and the preservation of sugar as far as possible from re-infection is an ordinary measure of precaution which should not be neglected. While this is so, it is clear that the maintenance of sugar absolutely sterile up to the time it is bagged is an impossible counsel of perfection under existing conditions, and it seems to the writers that the fact must be accepted that, no matter what care is exercised under moist atmospheric conditions, white sugars must always be liable to some extent to deterioration owing to the hygroscopic nature of the sugar itself.

To what then are we to attribute the variability exhibited by different samples of sugar in their liability to deterioration? While making due allowances for the probable effect of differing degrees of infection, it seems an unavoidable inference that some other factor is also present. Although exact observations on this point are still to a large extent lacking, there is some evidence to show that it may depend in some degree on the average size of the grains of the sugar. *Vesou* sugars exhibit considerable variability in the size of the grain, depending to some extent on the market for which they are designed, and on the fancy of the particular estate proprietor or factory manager. It would appear that large grained sugars may on the whole be less liable to deterioration than the finer grained types. This appears reasonable, since the finer the grain, the greater will be the surface of sucrose per unit weight exposed to the action of the air. Absorption of moisture can only take place at the surface of the crystal, and it follows that the greater the crystal surface exposed the greater will be the liability to deterioration.

There is also some reason to think that the effect may be to some extent influenced by the mineral content of sugars of this type. The actual amount of mineral matter contained in such sugars is very small in any event; and its exact measurement by ordinary methods of analysis is difficult, but qualitative tests on deteriorated sugars seem to indicate that a rough correlation may exist between mineral content and liability to deterioration. It is however hoped that it may be possible to investigate this point further in the future.

It has been stated that the practice of bagging sugars hot increases the liability to deterioration; inasmuch as the centre portions of bags of sugar retain heat for a larger period than the peripheral portions, distillation of moisture may take place from the central warmer portions accompanied by condensation in the cooler peripheral layers, thereby increasing the moisture contents of the latter and the consequent risk of deterioration. While this may be of importance in relation to sugars of lower grade, the initial moisture contents of *vesou* sugars are so low that it seems probable that the risk arising from this practice in relation to sugars of this class is not great. It seems to the writers that the practice of using sugar dryers and bagging hot may have something to recommend it on this account since anything tending to decrease the infection of sugar with micro-organisms is an advantage. On the other hand, there is no doubt that the hygroscopic power of these sugars is the principal contributing cause in their liability to deterioration; and, as it is impossible in practice to bag sugars in absolutely sterile conditions, it is *ceteris paribus* impossible to guard absolutely against risk of deterioration by any such form of treatment prior to or during bagging.

OBSERVATIONS ON CONDITIONS IN STORES AND GOODS SHEDS.

The buildings in which sugar is stored in Mauritius whether at the docks, on the railways or on estates do not differ very greatly in design, being usually rectangular, single storey buildings, built for the most part of stone, sometimes of concrete, and sometimes entirely of galvanized iron. They are usually roofed with galvanized iron; and the floors are usually of concrete or else paved with rough or squared stone. In buildings in which sugar is stored for long periods it is not uncommon to place pieces of wood on the floor to serve as dunnage, thereby avoiding the contact of bags directly with the floor, but this is by no means invariably followed.

In no case hitherto encountered has a provision of properly insulated floors been made in each warehouse. The bags of sugar are stocked in tiers, the ends of the bags usually being separated from the walls by a dead space of about one foot. The actual height of the tiers will naturally depend on the height of the building and varies between 15 and 30 bags.

It was observed in all storehouses examined that invariably whenever damage occurred it was particularly in evidence in relation to the undermost side of the lowest tier of bags in contact with the floor.[1] In some cases evidences of sweating were also met with in bags, the ends of which butted on to the gangways left to facilitate access to doorways, or opposite windows. Almost never were cases encountered in which bags forming the central part of tiers were contaminated.

It was further observed in cases when the bags were stacked on dunnage that the points of injury could always be traced to the parts of the bags in contact with the dunnage.

In view of these facts, it appeared an obvious inference that the occurrences observed might in all likelihood be due to local variations in temperature at the point of contact with the floor, due to the heat conductivity of the flooring materials following the daily fluctuation of temperature of the earth more closely than sugar.

In consequence, as we are bound to assume that the atmosphere in the sugar stores during the early months of the year is fairly close to saturation point, it seems reasonable to suppose that the local cooling which takes place at the ground level may suffice to produce amounts of condensation of atmospheric moisture at the ground level, or at any rate by cooling of the air to raise the relative humidity sufficiently to increase the moisture content of the sugar in contact with the bottom of the bags beyond the danger point.

Similar reasoning accounts for the effects shown in relation to the ends of the bags backing on the gangways, the liability of draughts to form there giving rise to local variations in temperature and consequently cooling and condensation.

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[1] The possibility that the deterioration of the under side of bags in contact with the floor may be due to contamination of the bags with destructible organisms at that point or with hygroscopic material occurring in the dust or dirt on the ground, is negatived by the fact that cultures prepared from scrapings taken from the outside of sweated bags did not show the prevalence, in any case, of organisms found to be specifically associated with sugar deterioration. Chemical analyses of similar samples from 6 different sugar stores did not show the presence of hygroscopic salts, i.e., chlorides or nitrates, in quantity sufficient to account for moisture absorption, while in those parts of the floors of sugar stores on which sugar had not been stored dry conditions were observed.

The bulk of the sugar in the warehouse having a high specific heat, and low conductivity, will show relatively smaller fluctuations in temperature.

It has not so far been found possible to check this reasoning by means of temperature records in warehouses in which sugar was being stored, but the following experimental observations throw some additional light on the matter.

IMPROVEMENT OF STORAGE CONDITIONS.

A series of experiments were laid down in railway goods sheds at the Rivière Dragon and Quatre Bornes in the latter part of 1920 with the object of ascertaining whether by varying the nature of the floor on which the bottom tier of bags was stored, the rate of deterioration was capable of being influenced.

The sheds were compact stone buildings with a stone floor and a galvanized iron roof; the capacity of Rivière Dragon shed is 26,000 bags, that of the Quatre Bornes shed less.

In both cases, the shed was divided into sections on which different forms of special treatment was given to the ground layer on which sugar in bags was subsequently to be stacked, At the Rivière Dragon the treatment was as follows:—(*a*) A tier of sugar bags filled with red earth; (*b*) a tier of sugar bags filled with black volcanic sand; (*c*) a tier of sugar bags filled with coal ashes; and (*d*) the remainder of the shed, no treatment.

The bags in section *a*, *b* and *c* were laid down on old railway sleepers and the bags of sugar subsequently piled thereon; while in section (*d*) the sugar was stacked directly on sleepers resting on the floor.

At the Quatre Bornes the floor of the goods shed was covered with a layer of cinders from the locomotives to a depth of 6 in.; on this two sections of bags filled with other material were placed viz.: (*a*) bags filled with red earth; (*b*) bags filled with black volcanic sand; (*c*) no treatment, the bags being stacked directly on the cinders.

At Rivière Dragon the bags of sugar were placed in the store during September to October 1920: and were withdrawn in February 17th, 1921. At Quatre Bornes, the sugar was placed in store in November 1920, and withdrawn on March 19th.

On examining the sugar it was found that at Rivière Dragon the under sides of the bags in contact with sleepers and with layer of bags containing insulating materials all showed signs of deterioration, but in a considerably varying degree, the remaining portions of these bags which had been in contact with bags filled with sugar showing no deterioration.

Section *a* and section *d* showed about the same degree of deterioration, the bottoms of the bags being markedly stained and sticky. Section *b* was slightly deteriorated but much less than sections *a* and *d*.. Section *c* was also deteriorated to a greater extent than *b* and less than *a* and *d*.

The insulating material contained in the bags in sections *a*, *b* and *c* was examined and found to be quite dry and pulverulent, except in so far as the topmost layer was concerned, which was to some extent rendered sticky by syrup formed as the result of deterioration of sugar in the overlying layer. The remainder of the sugar in the store was undeteriorated except in the case of the ends of bags flanking corridors which showed some deterioration.

At Quatre Bornes somewhat similar results were observed, deterioration being observable only on the bottom sides of the bags in contact with the insulating layers, though on the whole the actual deterioration which had taken place was less than at Rivière Dragon. The most marked deterioration had taken place in the case of sections *a* and *b* resting on bags filled with red earth and black sand. In section *c* in which the bags rested directly on a layer of cinders the deterioration observed was relatively very slight, the outside of the bags not being discoloured at all. It was only on opening the bags that some deterioration could be detected in the layer which had been in contact with the insulating material.

It should be added that the layer of ashes was composed of pieces approximately ½ in. diameter, and was markedly discontinuous, thereby tending to lessen variation of temperature by conduction.

The following additional observations on conditions observed on two of the estates examined throw further light in this matter. At an estate close to Rivière Dragon the sugar store showed a state of affairs similar to that recorded at the goods shed of that place. Bags resting directly on the floor were sweating badly on the under surface. On the estate a number of bags had been insulated from the floor by placing them on a layer of boiler tubes covered with gunny bags, the tubes supporting each bag at two points. It was found that those bags were very badly deteriorated indeed at the points of contact with the boiler tubes and hardly at all at the intermediate points. Other bags had been placed on fire bricks; they were much less deteriorated than the bags resting on the floor and on boiler tubes.

At another estate situated in the district of Pamplemousses the store was examined and it was found that no deterioration had taken place at all in the case of sugar stored there for over six months, notwithstanding the fact that in railway goods sheds in the same locality the usual features of deterioration had been recorded. It was found on examination that the store formed the building of an old factory and that the floor was built over two pits formerly used for storing molasses.

The floors were thus underlaid by a dead space of some 5 or 6 ft. deep. It is in the circumstances impossible to avoid the conclusion that the absence of deterioration in this case is due to the provision of a non-conducting layer beneath the floor, which had thus minimized variations in temperature, and so had diminished the rate of deterioration.

GENERAL CONCLUSIONS.

From what has gone before, it is clear that the cause of deterioration of *vesou* white sugar as observed in Mauritius is primarily the absorption of moisture from the atmosphere. If such sugar can be protected from absorbing moisture from the air, it will not deteriorate, but will keep indefinitely.

The fact that organisms capable of causing destruction of sucrose invariably exist in such sugars is a matter of small importance, since it is impossible commercially to produce absolutely sterile sugars under existing conditions, and if the moisture content does not exceed the danger point they cannot develop.

The question therefore of minimizing losses of this description consists essentially in protecting sugars as far as possible from conditions likely to lead to moisture absorption. In this connexion the construction of warehouses where sugar is intended to be stored is a matter of the greatest importance.

There is no doubt that existing warehouse accommodation requires to be considerably modified in form if the desired degree of protection is to be fully secured.

In the light of the information brought forward, it seems clear that warehouses for the storage of sugar should be solidly constructed; they should be fitted with doors and windows capable of being tightly closed to avoid currents of moist air; and above all they should be fitted with floors of non-conducting material.

Warehouses in which sugar is stored should be opened as infrequently as possible after the sugar has been placed therein; and for purposes of inspection it is desirable that protected or double doors should be provided so as to minimize the risk of air currents. To facilitate inspection in stores of this type, electric light would be a very desirable addition.

It is possible that some special provision could be made for drying the air inside sugar stores, but on this point it is not possible to pronounce a definite opinion at present.

It is however of interest to note that jute, of which material sugar bags are universally made, possesses great hygroscopic power. To exemplify this it may be stated that a sample piece of jute bag exposed to a damp atmosphere for 10 days had at the end of that time absorbed 35 per cent. of its weight of moisture. It seems not improbable that this property of jute may assist in drying the air in sugar stores to some extent and so may tend to counteract the conditions leading to deterioration.

Another practice that has been found of use in other countries in counteracting the tendency to moisture absorption lies in the use of crinkled paper linings for sugar bags which tends to protect the sugar from direct contact with the air.

It should not be inferred from the above observations that attention to cleanliness and the consequent diminution of infection with micro-organisms is to be neglected; but the fact remains that the prime cause of deterioration of white sugar lies not so much in the organisms which they contain, as in the atmospheric conditions at the point of storage.

Pittsburgh Meeting of the Sugar Section of the American Chemical Society.

The Autumn meeting of the American Chemical Society took place at Pittsburgh, Pa., from September 4th to the 8th. As at previous sessions, the Division of Sugar Chemistry was active, and thirteen good papers were read, short abstracts of which are given below. At these meetings Dr. F. W. Zerban presided, and Dr. F. J. Bates acted as secretary.

Counter-current Application of "Kelpchar" in the Decolorization of Syrup. J. W. Turrentine.—A process is described for the continuous, automatic, and counter-current application of "Kelpchar" in the decolorization of sugar solutions. Use is made of the best filter practice, the process admitting of the employment of the most adaptable of modern filters. Thus, vacuum or pressure filters or centrifugals may be employed, depending on the nature of the liquid to be filtered. By this process "Kelpchar," which is admitted at one end of the apparatus, is applied counter-current-wise to the liquid undergoing decolorization in as many applications as desired, and is discharged as spent cake; while the crude liquid is admitted at the end of the apparatus at which the spent cake is discharged and is delivered in a completely purified state at the other. Thus, upon entering the apparatus the liquid comes into contact with the practically spent carbon, and finally before emerging undergoes treatment with the fresh "Kelpchar" entering. In the one-stage application of a decolorizing carbon, the carbon first loads itself up with those impurities most easily removed, and finally adsorbs those least easily taken up. Thus, an excess of the reagent is required, and, further, an excess probably out of proportion to the decolorization to be effected. In the present system, "Kelpchar" that has been used to adsorb the impurities most difficult to remove is still available with unimpaired power to adsorb the impurities more easily adsorbed. In this way full use is made of the decolorizing properties of the "Kelpchar," and the most efficient application of that material results. The advantages gained are that smaller quantities of "Kelpchar" require re-activating, and losses of values are correspondingly reduced. The process admits of continuous and automatic operation, and labour and laboratory supervision are reduced to a minimum.

Preparation of Chars for the Sugar Industry. **C. E. Coates.**—Work carried on by the author during the past six or eight years was reviewed,[1] the more salient points mentioned being: (1) charred cane leaves and trash act as a filter-aid, and as a decolourizer when activated; (2) any form of impregnation in the preparation of decolourizing carbons is too expensive; and (3) the decolourizing activity of a carbon is in inverse proportion to its hydrogen content.

Vallez Rotary Filter-Press. **W. D. Horne.**—This newly introduced filter-press[2] differs from the preceding types of leaf presses in having its filtering discs set upon a hollow horizontal shaft which revolves slowly during filtration, insuring uniformity of deposit of cake upon the leaves. Paper pulp may be used as the filtering medium, which gives greatly increased speed of filtration; while the uniformity of the cake allows of sweetening-off with the minimum amount of water, and at the same time gives a very low sucrose content in the washed cake. Washing out is particularly effective, and the arrangement of parts allows of very rapid discharging, cleansing, and refilling.

Study of the Formation of Gum Levan from Sucrose. **W. L. Owen.**—The formation of gum levan from sucrose by bacteria is not, as has been claimed by previous investigators,[3] dependent upon its inversion and the utilization of invert sugar while in the "nascent condition." Experiments on the production of gum levan in the presence of added invertase show that under these conditions it is decreased to the extent to which the invertase is active. The decrease is always greatest where the conditions are most favourable for invertase action. The optimum pH for gum production is between 6·7 and 7·0, but the fermentation can proceed slowly where the pH is 9·5. Under the latter conditions the addition of invertase does not reduce the production of levan by the bacteria.

Detection of Sugar in Condensed Waters by Means of Cresol. **G. E. Stevens.**—Fifteen c.c. of cresol (U.S.P.) is dissolved in a castile soap solution (6 grms. in 100 c.c. of distilled water). The mixture is warmed until a complete solution is obtained. This solution can be made up in litre quantities in the above proportions without deterioration. Approximately 1 in. of water to be examined is placed in a 6 in. × ⅝ in. test tube and five to ten drops of the cresol solution is added, and thoroughly mixed. Cool if the water is hot, and add concentrated sulphuric acid from a dispensing burette, holding the tube in an inclined position so that the acid will run down to the bottom and form a separate layer, continuing to add the acid until the acid layer is ⅜ in. deep. The tube is then rolled between the palms of the hands, and if sugar is present a reddish black to pink colour ring will develop, the colour depending upon the concentration of sugar in solution. A white translucent screen is recommended, to be placed between the eye and the source of light, such that the colour reaction (which is recommended as preferable in point of economy and certainty to that given by α-naphthol) will be more easily recognized, especially in solutions containing very faint traces of sugar.

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[1] A fuller abstract will be published later.

[2] U.K. Patent, 181,879.

[3] *I.S.J.*, 1921, 51.

Hydrogen-ion Determination as a Method of Refinery Control. ***H. Z. E. Perkins.***—Direct control of acidity and alkalinity in sugar refining is obtained only at certain points, chiefly at the beginning. After washing, the sugar goes through the main processes of clarification, char decolorization, and crystallization without material change in ionization. By-products are unstable in composition, ferment quickly; and are, moreover, treated with defecating agents, acid and alkaline. Ionization, therefore, is variable, being the resultant of several factors, natural and artificial. The main products are highly crystallizable and light in colour, and thus are easily tested with colour indicators. They appear sluggish and uncertain however with the potentiometer. On the other hand, the lower products, which are dark, cannot be used in colour reactions, but they respond better to electometric tests. The working range in refinery practice need not exceed pH 4·0 to pH 6·8. In the discussion following, Dr. HORNE introduced the question why Cuban cane juice when it is limed to phenolphthalein alkalinity and heated gives increased reducing values; and Dr. ZERBAN stated that the acids formed during the decomposition of the reducing sugars by lime and heat are more than enough to neutralize all the alkali present, and that the presence of this acid is sufficient to account for the increased reducing values.

Invertase Value of the Clerget Constant. ***R. F. Jackson.***—It was shown that widely varying values have been obtained by various investigators. In experiments by Mrs. C. G. SILSBEE and the author[1] the value of 31·98 was obtained for the negative constituent; while by adding to this value corrections for the effect of the acid concentration on the rotation, approximately the various acid values for the Clerget constant that have been found by several investigators in different laboratories, using various concentrations of acid, were obtained.

Density of Solutions of Invert Sugar. ***R. F. Jackson.***—A series of density determinations of invert sugar solutions valid to three units in the fifth decimal. By comparison of these densities with those of equivalent sucrose solutions the contraction in volume accompanying the hydrolysis of sucrose was computed. The contractions as thus measured were calculated to a weight of 26 grms. of sucrose in varying volumes of solution, and the results plotted against concentration. The curve showed graphically that the contraction was the result of two effects, namely, the contraction caused by the chemical combination of a molecule of water and the hydration of the products of hydrolysis. In dilute solutions the latter was shown to predominate, and to be an important function of concentration. It was tentatively suggested that the variation in specific rotation with concentration is due to the varying degree of hydration.

Polarization of Mannitol in Presence of Borax. ***C. A. Browne.***—After reviewing the literature of the influence of borax on the polarization of mannitol, Dr. BROWNE described some experiments carried out by him in this direction. He has observed that a boric acid-mannitol compound is formed, which is more strongly acid (that is more highly ionized), and has a higher combining power than boric acid.

Comparative Colour Determination in Cane Syrups and Molasses. ***F. W. Zerban and S. Byall.***—The object of this investigation was to ascertain whether it was possible with the Hess-Ives tint-photometer to detect any difference in the specific transmissive index of cane products when the sample was in one instance dissolved in water and filtered with a small amount of kieselguhr, as previously practised by the authors,[1] and in the other diluted with white sugar syrup and filtered according to Peters and Phelps' method. It was found, with twelve cane products representing the entire colour range, that water dilution gave too low figures in 70 per cent. of the determinations, and too high figures in the remainder; the average difference was surprisingly small, 0·78 per cent. of the colour for the red lass; 2·13 per cent. for the green glass; and 6·28 per cent. for the blue glass. Only in a few individual determinations did the error due to water dilution exceed to any extent that attributable to the permissible error in the readings themselves. With the Hess-Ives instrument, therefore, the method previously used by the authors[2] is sufficiently exact for practical factory purposes. Conditions are, of course, different when the spectrophotometer is used.

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[1] See *I.S.J.*, 1920, 572.

Estimation of Caramel in Sugar Products by the Ehrlich Method. ***G. P. Meade.***—Ehrlich bases his method[3] on the claim that saccharan, a component of caramel, is not precipitated by lead subacetate. The present investigation shows that this is true only with saccharan dissolved in distilled water. If any of the ordinary impurities are present that form a precipitate with lead, then saccharan is carried down with the precipitate. Known amounts of saccharan, and of caramel, added to the molasses solutions, are largely removed by clarification with lead subacetate. Therefore, it is concluded that the Ehrlich method is valueless. In the discussion following M. J. Proffitt stated that he had never succeeded in preparing two batches of saccharan having the same colour value, even when more rigorous methods of purification than those prescribed by Ehrlich were followed. Part of the saccharan can be converted to a crystalline compound, but a part always remains as a tarry mass; so that "saccharan" appears to be an uncertain mixture rather than a definite chemical compound.

A Steam Heated Laboratory Vacuum Pan. ***J. F. Brewster.***—The body of the vacuum pan consists of an inverted bell jar with open, wide neck fitted with a rubber stopper through which pass the leads of the $\frac{1}{16}$ or $\frac{1}{4}$ in. coil of copper tubing, the feed or draw-off pipes. A second open neck bell jar, or better, the dome of a porcelain vacuum evaporating apparatus fitted to the body with a rubber gasket forms the top of the pan. Through the upper rubber stopper passes the connexion to the condenser.

A Simple Check Valve. ***J. F. Brewster.***—A check valve for use with the water vacuum pump to prevent sucking back is made by cutting part way through a solid rubber stopper at the narrow end, leaving a thin flap or disc. The stopper is then bored to receive a piece of glass tubing, the flap being left intact. The valve stopper is inserted in a short length of glass tubing wide enough to allow free play of the valve. By means of a second one-hole stopper, and glass and rubber tubing, the valve is connected between the pump and the apparatus to be evacuated.

Stainless steel valves for evaporators and pans have been proved to be greatly superior to those made of mild steel or even phosphor bronze. For example, mild steel flap valves were installed in the air pump attached to the vacuum pans of a certain cane sugar factory, when it was found that under the conditions of working the valves were seriously corroded, the life of these valves in fact being only about 3 weeks. A phosphor bronze valve certainly resisted the action of the vapours better, but gave out through fraying on the edges, small pieces breaking away. Its life was about 6 weeks. But a stainless steel valve was found to be capable entirely of resisting the action of the vapours; and, though installed 3 years ago, is still giving excellent service.

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[1] *I.S.J.*, 1920, 332.

[2] *I.S.J.* ,1922, 297.

[3] *I.S.J.*, 1910, 84-85.

Recent Work in Cane Agriculture.

FIJI DISEASE OF SUGAR CANE IN THE PHILIPPINES. *H. A. Lee, C. J. Welles, and M. G. Medalla. The Philippine Agricultural Review, Vol. XIV, No. 4, Fourth Quarter, 1921.*

The main object of this paper is to acquaint the planters in the Philippines with the outward appearance, cause, losses incurred, and method of prevention of this disease, and a series of excellent illustrations are interspersed for its easy detection. Our scientific knowledge of the disease is largely due to H. L. LYON, of Hawaii. It was first made known by letters from F. MUIR, when travelling in Fiji, which were printed in the *Hawaiian Sugar Planters' Record* in 1910. It was subsequently found in New Guinea and Australia, and is supposed to have originated in the former of these. Its first mention from the Philippines is in the *Annual Report of the Director of Agriculture* for 1919 as occurring in Mindoro; it was afterwards found in Laguna and Batangas, and in August, 1921, in Mindanao. This shows that it has obtained a firm foothold in the islands and has already a wide distribution. It is considered probable that it was introduced with cane cuttings from Australia.

Description.—The gross effect is one of stunting, plants having much the appearance of having been bitten off by a horse or buffalo: there is an abnormal production of shoots from the upper eyes, giving a bunching appearance. The leaves are shorter and blunter than usual, and in old canes much narrower. Always associated with the disease are elongated galls on the under surface of the leaves, varying in size from infinitesimal to several centimetres long, and these occur more abundantly towards the lower half of the leaf. The galls are often not developed till the disease is well established. Such canes as are formed are usually brittle and easily broken.

Cause.—A great number of theories have been formed as to this—poor soil, lack of aëration, gravel under plants, too much or too little humus, and so forth; but experiments have shown that if diseased cuttings are used, Fiji disease will appear in any kind of soil. LYON first noted an organism in the galls allied to *Plasmodiophora brassicae*, and, as this latter is a well known parasite and no other plausible theory has been formulated, it is generally regarded as the cause of the disease. It appears to be capable of transmission to some extent from plant to plant, but no agent or carrier is at present known. There is clear evidence of transmission from crop to crop by using diseased cuttings.

Losses caused.—The diseased plants commonly appear sporadically in the fields, but occasionally the attack may be termed devastating, and a field is totally destroyed. Any plant infected at once ceases in the growth of the stem, and if the plant is young no stem at all is formed, but merely a bunch of grass-like leaves. One manager estimates the loss on his estate at 25 per cent., and, in an actual field count in newly infected fields in Negros, the reduction of yield was found to be 10·6 per cent. Taking the usual profit in cane-growing as 10 per cent. on the capital, it is thus seen that this disease is easily capable of rendering cane planting unprofitable, let alone losses from mosaic, smut, top-borer, and other Philippine cane diseases. The losses due to Fiji disease may be reduced by eliminating affected plants, always selecting seed from healthy fields or estates, and choosing such canes as Badila, which appears to be more or less resistant to attack.

Recent Work in Cane Agriculture.

SACCHARUM SPONTANEUM. *C. Rivière. Comptes Rendus de l'Academie d'Agriculture de France, VI, 38, December 1920. (Bulletin of Agricultural Intelligence, Rome, XI, 10, October 1920.)*

The author gives a short account of this wild species of Saccharum in the Mediterranean, and especially in Algeria where he introduced it some fifty years ago to the Experimental Station. It is now spreading over the eastern portions of the Mediterranean and has established itself in a few spots in Algeria. The plant grows to a height of 2-3 metres, with a dense bushy habit and an underground rhizome which spreads far and wide. It is easily propagated by cutting pieces of the underground stem with one or two upright branches, strikes quickly and resists drought although growing well and luxuriantly when irrigated. It occurs chiefly in low marine climates, but is less at home on high ground where the temperature falls below freezing point. It is of use in protecting sand dunes, reclaiming marshes, holding up the sides of ditches and irrigation channels. When dried it serves a variety of purposes, such as fencing, roofing, packing, etc. In the green state it is a useful fodder when young, but if old can only be used as silage, especially for animals that are not particular and in times of drought. There is, however, a danger in its use near cultivation, and that is in its insect pests, such as *Sesamia nonagrioides*: it is therefore unwise to fence crops with it or use it as a windbreak. The full grown insects emerge from the dried stems and rapidly infest practically any crop, from vines and market garden crops to the larger cereals and sugar cane.

ÉLÉVAGE ET ÉPREUVE DES SEEDLINGS DE CANNE: METHODES EMPLOYÉES A LA STATION AGRONOMIQUE. *Journal de la Station Agronomique de la Guadeloupe. Vol. I, No. 4, 1921.*

Flowers are sufficiently mature to be cut in the beginning of December, and a close watch is kept of the varieties available at this time. Immediately after cutting the inflorescences are placed in muslin bags and these are exposed to the air for several days. When dry the flowers are easily separated, the bits of stalks are removed and the bags placed in the sun for seven to eight days, after which the seed is ready for planting. Seed boxes should not be more than 60 cm. by 30 cm., for ease in moving rapidly. A layer of stones and dry leaves is placed at the bottom for drainage, and the boxes are then filled little by little with earth, shaking them meantime: on the surface a thin layer of seed is spread and covered by fine earth just sufficiently to hide them. If kept moist in the air and light the seeds should germinate in five-six days, but the time will depend on the climatic conditions at the time when the inflorescences are cut. Shortly after emerging, a weak solution of potash and nitrogenous manure will greatly help the development of the seedlings. When 2·5 cm. in height (in the beginning of January) the young seedlings are potted up in bamboos and these are placed under cover for several days before being brought again into the free air. Early in April the seedlings should be 40 cm. high and the first selection takes place, weak ones being rejected, and the most vigorous planted out in prepared plots in the field. The seedlings are still delicate and require watering in dry weather. About a year afterward the most vigorous clumps are cut, weighed and tested for sucrose, and those giving the best results are grown on, the stools being split into two and replanted. In October-November about 50 cuttings will be obtained for each kind and these are planted among well known kinds for comparison, each seedling now receiving a definite number. At harvest they are again cut, weighed and analysed, and those reaching the required standard preserved, the rest being thrown away. In the third year the selected seedlings are planted in plots of 100 in different localities and compared with the local varieties under the same conditions.

SUGAR CANE ROOT SYSTEMS: STUDIES IN DEVELOPMENT AND ANATOMY. *T. S. Venkatraman and R. Thomas. Agricultural Journal of India, XVII, IV, 1922 (being a paper read at the Indian Science Congress, Madras, 1922).*

This paper covers new ground, and its aim is to draw attention to the necessity of studying the root systems of sugar cane varieties used for crossing purposes. The actual study of the sugar cane roots is preceded by a consideration of some trees either liked or disliked in the fields, and the excellent illustrations of the dissected root systems disclose the reasons for this. The sugar cane in India grows under the most various conditions of soil and moisture, and a considerable part of the paper deals with the differences between the same kinds growing under different surroundings and different canes growing in the same environment. Numerous plates illustrate the writer's points, and the letterpress is more in the nature of a running comment on these plates than a detailed description of the various types of root systems. A very cursory glance at the plates will be sufficient to demonstrate the great differences which exist in cane roots, and a study of them will well repay those interested in raising seedlings for any special local climatic conditions. Most attention is directed to the raising of seedlings capable of withstanding drought, and the considerable success attending the trials of certain seedlings, raised at Coimbatore, with *Saccharum spontaneum* as male parent, is clearly traceable to the way in which these seedlings have taken on the deep-rooted character of this hardy wild grass.

The methods adopted in the root dissection are briefly alluded to, and are as follows:—(1) The laborious and methodical digging out of the whole of the roots by undermining operations commenced from one side, fixing each root in its place when freed, taking notes at frequent intervals and photographing the whole system after whitening it for the sake of contrast; (2) the digging of vertical trenches on each side of the plant and encasing these two sides of the earth column in wire netting, with thin iron rods driven from one side to another to keep the roots in place when the earth is washed away by a jet of water; (3) the previous preparation of the soil by laying down wire netting at different levels. This is a method designed by the senior author, and he claims that it answers very well, although of course it can only be of use for varietal tests, because of the disturbance of the normal soil conditions. On the whole we think that the first method is the best, given supervision and plenty of time and labour; the second for general touring, when the conditions for detailed study are less favourable; and the third for the special purpose of indicating varietal differences, once it is proved that the profound alteration in the physical conditions of the soil does not bring in a disturbing factor. After all, root dissection should not be undertaken without accepting the fact that it is a long and laborious process.

CANE PESTS (OTHER THAN WHITE GRUB) IN QUEENSLAND. *Monthly Circulars by the Entomologist, E. Jarvis, from August, 1921, to February, 1922. Bureau of Experiment Stations, Queensland.*

The observations and experiments on White Grub detailed in these Circulars were digested in the August number of this Journal, and those on the Weevil Borer and Large Moth-borer are dealt with here.

1.—*The Weevil Cane Borer or Cane Beetle* (*Rhabdocnemis obscurus*). This weevil or a similar pest is occasionally very destructive in various parts of the world, although perhaps it more usually attacks isolated clumps and is then of no great economic importance. JARVIS[1] estimates that thousands of tons of cane are destroyed every year in Queensland, and states that Badila seems to be specially sought out by the weevil. On a visit to New Guinea, TRYON, then Government Entomologist, discovered a Tachinid fly (*Ceromasia sphenophori*) parasitizing the weevil, and this was introduced into Fiji in 1911, where it quickly spread and is reported as successfully controlling the borer. In 1914 it was also introduced into North Queensland by the Colonial Sugar Refining Company, and was bred and liberated in the Johnstone district.

Serious outbreaks of cane weevil being reported, steps were taken in September, 1921, to breed the parasitic fly in considerable quantities in order to liberate it in the affected districts. That such inroads of the beetle borers should occur where the fly is present indicates either that it is ineffective in its control or that it is held in check in some way or other. JARVIS draws attention to the practice of burning the cane trash after harvest, which, while destroying large numbers of the beetle will also do the same to the fly, and hazards the suggestion that continued indiscriminate burning may result in the disappearance of this useful parasite from the tract. He therefore suggests that farmers should leave small patches of badly infested canes in order to serve as breeding grounds for the parasite.

A number of the flies were collected, and were successfully bred, the first generation emerging at the end of October. This first brood was, however, retained for further breeding, but it was hoped that there would be large numbers available before the weevil commenced its ravages on the new canes in 1922.

Bait-collecting has led to great results in the past and should not be lost sight of in fighting the weevil. Pieces of split cane about 18 inches long are stacked in small heaps of 10/20 near the canes, and these heaps are examined every alternate day, the beetles collected and destroyed. Experiments made in Fiji have shown that diseased cane has considerably greater attraction for the beetles than sound cane, but that the plan of smearing them with molasses has no appreciable advantage. If placed in the fields at harvest time these bait traps are found to attract numbers of the beetles for many days. As 3600 beetles weighing 1 lb. are capable of destroying five acres of cane, this is a cheap and effective way of diminishing their numbers. It has been maintained that H 146 does not appear to attract the beetles, and a trial plot has been put down in a field of D 1135 canes in a badly infested area to test this statement.

2.—*The Large Moth-borer* (*Phragmatiphila truncata*). JARVIS states that this moth-borer was reported as a cane pest in New South Wales as long ago as 1891, and there were injurious outbreaks in Queensland in the Mulgrave district in 1907 and at Bundaberg in 1909. Although there would appear to be little reason for it, this pest is not infrequently confused with the weevil by planters. It attacks the young shoots of plant canes and ratoons and, when boring into grown canes, is usually found chiefly at the top, whereas the weevil never injures the young shoots and prefers the base of the cane plant to bore into; the grubs also are entirely different. The method of attack is as follows. One or more minute holes, one-sixteenth of an inch in diameter are bored in the affected shoots; these, however, ventilate the inner tissues and allow an easy entry for enemies of various kinds, e.g., the common ant (Pheidole) which accounts for large numbers of the small grubs. Besides the ant, two Hymenoptera are recorded as parasitic in New South Wales; *Apanteles nonagria* is credited with destroying 50 per cent. of the boring grubs and *Euplectes howardi* attacks the pupa and prevents the emergence of myriads of the moths. Probably these and others are present in Queensland; a large Tachinid fly for instance has been collected at Pyramid.

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[1] Notes on Insects damaging Sugar Cane in Queensland. E. JARVIS. *Bull. 3, Division of Entomology, Bureau of Sugar Experiment Stations, 1916.*

Apanteles nonagria was first recorded by OLIFF in 1893 and was found by JARVIS in Queensland in 1919. It is thought to effectively control the moth-borer in New South Wales and JARVIS considers that this is also so in the Cairns district in Queensland. A number of specimens were found and placed with borer grubs in a cage. The observations were of unusual interest as the life cycle differs in several respects from that of Ceromasia which parasitizes the weevil borer. The wasp is extremely small, being no larger than a sand-fly; it lays as many as 100 eggs and completes its transformations in three weeks, so that there is little wonder that it is effective in its control. The female pierces the caterpillar with its sharp ovipositor and inserts its eggs; these produce small maggots which at once begin to feed on the internal organs of the caterpillar; the larval stage lasts about 14 days, when the maggots leave the body and, remaining together, spin white, egg-like, silken cocoons which form a flattened mass behind some dead leaf sheath or actually inside the moth-borer's tunnel; in a few days the wasps emerge. As numbers of the parasite had been reared, it was hoped soon to distribute quantities in the infested districts.

REPORT OF THE OPERATIONS OF THE DEPARTMENT OF AGRICULTURE, MADRAS PRESIDENCY, 1920-1921. *Superintendent, Government Press, Madras, 1921.*

Owing to the cutting down of the length of this Report, sugar cane matters are very briefly dealt with. Varietal and manurial tests were carried out as usual but none of the results are given. At the Samalkota Farm, the Java varieties appear to continue to give satisfaction, J 33 and J 247 having produced an average of 11,000 lbs. of jaggery during each of the past three years. Eleven varieties were grown at Palur and five at Taliparamba farms. Of the five kinds grown at Coimbatore farm, Co 1 gave the best jaggery but only a moderate yield. A trial of replanting the stubble canes of the previous year reduced the cost of planting, but the resulting yield was lower, and the practice is not therefore recommended for ordinary crops. Similarly the planting of the sets in pits, now tried for three years, although giving higher yields, was found to cost too much, the digging of the pits alone costing Rs. 115 per acre; the experiment will now be discontinued. Trials at Samalkota with fish guano as against castor cake were successful and showed that the fish guano could usefully replace the castor.

The reference to the Cane-Breeding Station is also very brief, and the interesting annual report of the sugar cane expert is not, as on former occasions, reprinted. The work was continued on the usual lines, namely, the breeding of new seedlings for trial in north India against the local inferior kinds. Five new strains were finally passed out of the station during the year, bringing up the total thus selected to 38. The fact that the Mungo group of canes never before known to flower produced a mass of inflorescences during this year has been referred to elsewhere, but we learn now that although this is a distinct step in advance all the flowers were unfortunately sterile, so that they could not be used in breeding work. The fact that the sugar cane expert in charge of the station has succeeded in his pollen work has also been elsewhere mentioned.

PRINCIPAL VARIETIES OF CANE GROWN IN 1919, 1920 AND 1921. *The Journal of the Board of Agriculture of British Guiana. Vol. XIV, No. 3, July, 1921.*

This article consists of a number of tables giving the acreage and yields of the chief varieties of cane grown, and a few of the facts are here repeated. The first table gives the acreage of about 30 varieties during the past three years,[1] together with the increases and decreases in 1921 as compared with 1920. The kinds grown in 1921 on more than 1000 out of a total of 65,869 acres were as follows:—D 625 37,240 acres, Bourbon 2337, D 625 mixed with Bourbon and other seedlings 9150, D 145 4935, D 118 3152, B 208 2254, D 419 1688. D 625 shows the greatest increase of 1140 acres, while the greatest decreases were in Bourbon of 589 and B 208 of 864 acres. The second table gives the percentage areas covered by 15 varieties during the past five years, 1917-1921. The increase in D 625, we see, is confined to the last three years, the relative figures being 46·2, 50·9, and 56·5 respectively. Bourbon, on the other hand, has steadily declined during the five-year period, from 9·4 to 3·5 per cent., and B 208 in a less degree from 6·4 to 3·4. A considerable increase is to be noted in the mixed crops referred to above, although there is no indication as to which member is predominant in the mixture.

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[1] For an analysis of a similar nature for 1920 see *I.S.J.*, 1921, p. 175.

The distribution of the varieties according to origin is interesting, as showing the great decline in growing exotic varieties in British Guiana of whatever character. Bourbon and the older varieties decreased from 16·7 to 8·8 per cent. in the five-year period; Java varieties increased from 0·4 to 1·1 per cent.; Barbados seedlings declined from 7·1 to 4·4 per cent.; while British Guiana seedlings increased from 75·8 to 85·7 per cent. The average yields in sugar per acre for the most widely distributed kinds were as follows:—D 625 1·66 tons, Bourbon 1·75, D 145 1·61, D 118 1·72, B 208 1·61, and D 419 1·61. Against these, kinds grown on smaller areas usually showed larger yields; for example, Java seedlings 1·99, Ba 6032 2·44, BH(10)12 2·35, D 216 2·09, and D 167 1·81; while 13 varieties grown on large scale field trials gave all of them over 2 tons of sugar per acre, with the exception of B 3922, which gave 1·99. This diminution in yield on larger areas might have been remarked on, as we are not able to judge whether it is due to a difference in the character of the soil or in the care taken of the crops grown on smaller areas.

C. A. B.

American Commerce Reports.[1]

THE WORLD SUGAR SITUATION.[2]

The abnormal surplus of Cuban sugar existing last January has apparently been absorbed, and, in addition, the normal amount of new Cuban crop has been taken. The revised estimate of world production for 1922 is 1,600,000 tons over the earlier estimate, owing largely to the unexpected size of the Cuban crop. But this year's consumption also has exceeded all predictions, both in the United States and in Europe, and even with the revised crop figures for 1921-1922 the carry over for 1922 will be not far from normal. The gradual rise in c. and f. price of Cuban raws to the present level, about double the low figure of 1·75 cents at the end of 1921, has no doubt been due to replenishing of invisible supplies and increased consumption, and in particular to European demand.

The rapid distribution of the Cuban surplus since the beginning of the year is shown by the export figures for the first seven months of 1922 and the United States exports for the same period. Cuba exported 4,000,000 tons, including practically all its old-crop sugar, as compared with 1,800,000 tons for the first seven months of 1921. Of this the United States imported 3,000,000 tons and Europe 800,000 tons, as compared with corresponding figures for 1921 of 1,540,000 and 160,000 tons. The United States exported 755,000 tons of refined sugar in the first seven months of 1922 (85 per cent. to Europe) and only 256,000 tons in the corresponding period of 1921.

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[1] Culled from "Commerce Reports," published by the Department of Commerce, Washington. In many cases these are abbreviated here.

[2] Compiled by E. G. MONTGOMERY, Chief of Foodstuffs Division, Washington, Sept., 1922.

Comparative World Supplies and Consumption.—The following table states briefly the present situation in sugar, so far as data are available:—

COMPARATIVE WORLD SUPPLIES AND CONSUMPTION.

Periods.	Carry over, first of year.* Tons.	Estimated production. Tons.	Estimated consumption. Tons.	Final carry over, end of year. Tons.
Pre-war	750,000	17,500,000	17,500,000	750,000
1921	1,216,000	16,682,000	16,198,000	1,700,000
1922	1,700,000	17,490,000	18,360,000	830,000
1923	830,000	†17,000,000	—	—

Pre-War and 1922 Consumption.—Figures for the pre-war consumption of the principal countries and estimates for 1922 are given in the following table, the 1922 figures being based on various well-known statistical sources:—

PRE-WAR AND 1922 CONSUMPTION OF IMPORTANT SUGAR-CONSUMING COUNTRIES.

Countries.	Pre-war average, 1912-1214. Tons.	1922 Estimates.‡ Tons.
United States	3,800,000	§5,500,000
Argentina	210,000	225,000
Brazil	320,000	360,000
Canada	290,000	360,000
Mexico	125,000	110,000
Austria	700,000	110,000
Hungary		55,000
Czechoslovakia		300,000
Belgium	200,000	150,000
Denmark	106,000	150,000
France	705,000	800,000
Germany	1,500,000	1,450,000
Italy	175,000	270,000
Netherlands	125,000	210,000
Norway	133,000	85,000
Poland	‖100,000	145,000
Sweden	152,000	200,000
Switzerland	120,000	130,000
United Kingdom	2,000,000	1,600,000
Australia	250,000	280,000
British India	3,270,000	3,000,000
China	447,000	800,000
Japan	323,000	500,000
Other countries	2,449,000	1,570,000
	17,500,000	18,360,000

Preliminary Figures for World's next Sugar Crop.—Estimates derived from like sources of the 1922-23 sugar crop available to date are as follows:—

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* This is carry over from one crop to another and not stocks on January 1st. The 1922 figure, for example, represents carry over from the crop of 1920-21.

† A rough estimate, based on returns from the principal countries, which are given later in this article.

‡ 1921-22 sugar year for Continent of Europe.

§ Including replenishment of invisible stocks.

‖ Former Russian Poland only; the consumption of former Austrian and German Poland is included in the figures for Austria-Hungary and Germany.

American Commerce Reports.

PRELIMINARY ESTIMATES, 1922-23 CROP, AND PRODUCTION, 1921-22.

Countries.	1921-22. Tons.	1922-23. Tons.
United States:		
Beet	911,000	581,000
Louisiana cane	290,000	208,000
Cuba	4,000,000	3,600,000
Porto Rico	385,000	510,000
Dominican Republic	225,000	
Java	1,650,000	1,659,000
Australia	299,000	300,000
Fiji Islands	65,000	52,000
Mauritius	200,000	250,000
Natal	150,000	140,000
Formosa and Japan	425,000	325,000
British India	2,500,000	2,500,000
Europe	4,088,000	4,600,000
All other countries	2,302,000	2,275,000
Total	17,490,000	17,000,000

SUGAR BEET CULTIVATION IN DENMARK.

There are at present nine sugar factories in operation in Denmark, employing approximately 6000 workers. Seven of these factories are controlled by the Danish Sugar Factories, one by the sugar-beet growers themselves, and one by an independent company. With the exception of the factory at Gorley, all the plants are located on the two southern Danish islands of Lolland and Falster or in the western part of the island of Fyn, these localities being the only ones where the soil is adapted to the cultivation of sugar beets.

The area under cultivation increased steadily from 1882 to 1914; since then the growth and production of sugar beets has remained about the same from year to year, with the exception of 1919, when the peak of both the area planted and the crop yield was reached. The table which follows shows the area under cultivation, the crop yield of beet sugar, and the consumption of sugar per capita for the years 1912-1915 average, and 1917 to 1921:—

Year.	Area under cultivation. Acres.	Beet Sugar produced. Metric tons.	Yearly per capita consumption. Kilos.
1912-1915	80,000	139,120	40·31
1917	88,000	134,900	46·46
1918	90,000	141,300	41·00
1919	100,000	152,470	44·00
1920	95,000	135,220	40·30
1921	85,000	143,000	41·00

The Danish sugar industry has developed under a protective tariff. In May, 1908, an import duty of 10 ore per kilo was imposed, and at the same time an internal-revenue duty of 7·5 ore per kilo was laid on sugar. (There are 100 ore in 1 crown. One crown = $0·268 at the normal rate of exchange.) In 1921 Denmark inported 4,300,000 kilos of sugar, mostly cane sugar, and exported 9,200,000 kilos, 5,700,000 of the total amount exported going to England.

The figures in the foregoing table show a decrease of about 10 per cent. in the area under cultivation in sugar beets for 1921 as compared with 1920, but the production was greater. This decrease is due to the difficult economic condition of that year, and especially to the high cost of labour, which absorbs such a relatively high percentage of the total cost of sugar-beet raising, and, to a limited extent, to the fact that the land may have become exhausted owing to the difficulties experienced in obtaining fertilizers during the years of the war and the subsequent period. Growers have, therefore, through their representitives in the lower House of Parliament, advocated a reduction in the internal-revenue tax, claiming that with an average yield of 105 to 115 kilos to an acre, sold at the standard price for 1921 of 2·75 crowns per kilo, they were losing money. It is not believed, however, that the tax will be reduced, but it is anticipated that the labour cost per acre, which in 1921 was estimated at 110 crowns, will be materially curtailed and that the cultivation of the sugar beets will soon again be placed on a well-paying basis.—[Consular Report, August, 1922.]

Publications Received.

Distillation Principles and Processes. By Sydney Young, M.A., D.Sc., F.R.S., and collaborators. With 210 illustrations. (Macmillan & Co., Ltd., London.) 1922. Price: 40s. net.

This is an important addition to our literature of the subject. Every chemist is acquainted with the very excellent work by Dr. YOUNG, entitled "Fractional Distillation" (which has been out of print for some years), dealing with the difficulties of complex volatile mixtures, with the comparative value of different types of still heads, and with the interpretation of the results obtained; but the volume before us is not merely a new edition of the earlier work. Its scope has been much extended; and now with the collaboration of six specialists sections dealing with distillation on the technical scale in the alcohol, coal tar, petroleum, glycerin, and essential oil industries have been contributed. It is the section on the distillation of alcohol on the manufacturing scale that will interest our readers most, and these chapters have been contributed by the Hon. F. R. HENLEY and Dr. JOSEPH REILLY. These gentlemen have arranged their material well, not only on the theoretical side, which reviews the available knowledge of the principles underlying the distillation of mixtures of water, ethyl alcohol and other volatile products of distillation, but also on the practical side, which deals with the various types of stills and rectification apparatus in most general use. They supply in a readily readable form much fundamental and practical information, which should be the possession of all who are connected with the industry of the fermentation and the distillation of ethyl alcohol.

Alcohol in Commerce and Industry. By Charles Simmonds, O.B.E., B.Sc., F.I.C., F.C.S. Pitman's Common Commodities and Industries Series. (Sir Isaac Pitman & Sons, Ltd., London, W.C.2.) 1922. Price: 3s. net.

Mr. SIMMONDS' comprehensive textbook on alcohol, its production and application, which was published in 1920,[1] is now well known and appreciated by chemists; and this small volume may be regarded as an abridged edition of it, adapted to the use of the student and general reader. It is written in clear language, and the various technical expressions that arise are clearly explained. Quite a wide scope is covered, the text dealing with the manufacture of alcohol from starchy and saccharine materials and from cellulose substances; the varieties and properties of alcohol; industrial alcohol; power alcohol; alcoholometry; and methyl and higher alcohols; while lastly some statistical data are contributed. Necessarily a good deal of the information is scanty; for example, that treating of the production of alcohol, including the processes of fermentation and distillation; but nevertheless the book will well serve its purpose, namely that of a reliable primer for the acquisition of some knowledge of the part played by alcohol in commerce and in industry.

Filtration. By T. Roland Wollaston, M.I.Mech.E. Pitman's Technical Primers. (Sir Isaac Pitman & Sons, Ltd., Kingsway, W.C.) 1922. Price: 2s. 6d.

This is a small treatise on modern industrial methods for the filtration of liquids and gases. It deals *inter alia* with theoretical matter, as the physical action of filters, and chemical and bacterial action in filtration; but is mainly devoted to describing the best-known apparatus at present used for the filtration of public supply water and industrial solutions of many kinds. There is also a short chapter on centrifugal filtration. On the whole the information imparted in the pages of this small book is of a very elementary nature; but nevertheless, owing to the clear descriptions of the principal apparatus and methods used in filtration at the present day, the volume should be of distinct service to students, operatives and others who may desire a general insight into the subject.

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[1] *I.S.J.*, 1920, 103.

Some Chemical-Physical Themes. By Alfred W. Stewart, D.Sc. (Longmans, Green & Co., London.) 1922. Price: 21s. net.

Prof. STEWART (of Belfast University) is well-known as a particularly lucid writer of books on chemical topics, these publications having as their purpose the bridging of the gap between the original literature and the text-book. He is the expositor *facile princeps* for the chemist; and there are few if any better written works of their kind than his "Chemistry and its Borderland," which has been so widely read and appreciated. Now he has turned to physical-chemical themes, and provides the reader with an account of a variety of subjects, some of which have never been treated in a book of this kind, so that the student is compelled to delve through the pages of the proceedings and transactions of the journals, a toilsome task, and one that may be uncertain if he has not acquired a due sense of perspective. Among these subjects may be mentioned the theory of indicators, colloids, adsorption, catalysis, spectra, chemical affinity, recent work on the periodic law, and views on atomic structure, in the last mentioned of which the important researches of Rutherford, Bragg, Lewis and Langmuir, and others, are treated. This book is highly recommended to those who would keep abreast of developments in physical chemistry, many of which may have some practical bearing, and most of which are attracting not a little attention at the present time.

Proteins and the Theory of Colloidal Behaviour. By Jacques Loeb. First Edition. International Chemical Series. (McGraw-Hill Publishing Co., Ltd., London.) 1922. Price: 15s. net.

This book forms an interesting contribution to colloid chemistry, and is a volume that should be studied by reason of the exposition of fundamental theories which it expounds. Colloid chemistry has been developed on the assumption that the ultimate unit in colloidal solutions is not the isolated molecule or ion, but an aggregate of molecules or ions. Since it seems improbable that such aggregates could combine in stoichiometrical proportions with acids, alkalies, or salts, the conclusion has been drawn that electrolytes are adsorbed on the surface of colloid particles according to a purely empyrical formula. However, Mr. Loeb's investigations have led to the result that this last conclusion is based on an error involved in the methods of investigation applied, as far as the proteins are concerned, namely, to the failure to measure the H-ion concentration of the protein solutions, one of the main variables. When the H-ion concentrations are duly measured and considered, it is found that proteins combine with acids and alkalies according to the stoichiometrical laws of classical chemistry, so that the chemistry of proteins does not differ from that of colloids.

Fourth Report on Colloid Chemistry and its General and Industrial Applications. (H.M. Stationery Office, Kingsway, London.) 1922 Price: 5s. 6d. net.

As pointed out on the occasion of the appearance of the three previous reports,[1] this volume critically summarizes in the form of reviews by responsible authorities the work done during the past two years on colloidal chemistry both from the academic and practical points of view. In this fourth report appear papers on colloid problems in analytical chemistry, cataphoresis, lubrication, the preparation of liquid fuels, and other subjects, and for those interested in any aspect of colloidal chemistry the publication is an important one.

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[1] *I.S.J.*, 1919, 460; 1920, 704.

Brevities.

The last annual accounts of the Anglo-Ceylon & General Estates Ltd., show a drop in the net revenue from all sources from £230,558 to £80,990, this being due to the profits from the company's sugar estates falling to £14,392 as compared with £317,980 in 1920-21. As a result, the dividend was only 15 per cent. compared with the 35 per cent. in the previous year.

The U.S. Bureau of Chemistry is reported as advising the use of the enzyme invertase in the manufacture of table syrup for the inversion of the sucrose.[1] Cane syrup (as made in Louisiana) will crystallize if concentrated beyond a certain density; while, on the other hand, if it is too thin it will of course ferment. It is said that by hydrolysing the sucrose, a higher concentration may then be attained without danger of "sugaring"; and it is advised that this hydrolysis should be effected by means of invertase, using about 1 lb. per 800 gallons of syrup.[2]

Those concerned with the subject of the denaturing of industrial alcohol will find several arguments against the use of wood spirit set forth by Prof. Effront,[3] who proposes instead the use of saponines. R. P. Duchemin[4] replies in some detail to the several points raised, and certainly makes out a strong case for wood spirit being the most generally suitable denaturant (apart from its price), at any rate for conditions in France. As to saponines, these bodies cannot be regarded at all as proper denaturants, since they are separable by simply distilling the spirit.

E. Haddon,[5] of Mauritius, has obtained a particularly well clarified liquor at 30° Bé. (54° Brix) in the laboratory by operating in the following way: raw cane juice was sulphited to 2·25 grms. of SO_2 per litre, treated with one per cent. of decolorizing carbon ("Norit") in the cold, filtered while still cold, neutralized by lime, heated to boiling, and re-filtered, being finally evaporated to the density named in an iron vessel. It is stated that the liquor thus clarified was as clear and limpid as water, and gave no precipitate with ferric salts, thus proving that the polyphenols had been completely adsorbed.

Experiments have been carried out by English firms on the use of palm oil as a motor fuel,[6] using a 50 h.p. engine of the semi-Diesel type without any structural alterations. In general these experiments have proved satisfactory, it is stated. At 300 revs. per min., the power was reduced from 50 to 44·1 h.p., due to the lower calorific value of palm oil, compared with that of crude petroleum. After a run of six hours' duration, the piston and cylinder were free from carbonaceous deposit. In France also,[7] using a 2-cycle and 4-cycle engine made by a Manchester firm, this vegetable oil provided an efficiency fuel.

The Sociedad Nacional de Agricultura, of Rio de Janeiro, Brazil, has carried out experiments with alcohol fuel mixtures[8] using two Benz cars, the first receiving 20 litres of a mixture of 65 parts of alcohol (95 per cent.), 25 of ether, 9·5 kerosene, and 0·5 pyridine; and the second 20 litres of a mixture of 83 parts of alcohol, 10 of ether, 5 of kerosene, and 2 of pyridine. The first car had an easy start and an easy run, but the second had difficulty in starting, the motor running smoothly (it is said) only at the end of the trip. The consumption of the two cars was 98·5 and 129 c.c. per metric ton per 45 kilometres; while an American car consumed 126 c.c. of gasoline over the same distance. At the Campos sugar mills, alcohol (95 per cent.) sells at 275 reis per litre (27 cents. per U.S. gallon at present exchange), but the price of gasoline in Rio is 750 reis.

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[1] *Facts about Sugar.* 1922, **14**, No. 8, 150.

[2] Nearly 40 years ago, F. W. Thompson (assistant to Cornelius O'Sullivan) worked out his "yeast process" of making invert sugar (B P., 8686 of 1884). Liquor was heated with 1 per cent. of brewers' yeast at 130° C. for five hours; and this process was put into large scale practice for a time with good results for the manufacture of liquid invert sugar. However, from information given us by the late B. E. R. Newlands, it appears that it was impossible to apply the process when making solid invert sugar, as the product would never "set," but remained in a pasty mass, the precise reason for which condition was never definitely determined.—Ed., *I.S J.*

[3] *Moniteur scientifique du Quesneville*, December, 1921.

[4] *Chimie et Industrie*, 1922, **7**, No. 6, 1213, 1221.

[5] *Revue Agricole de l'Ile Maurice*, 1922, No. 1, 22.

[6] *Bulletin of the Imperial Institute*, 1922, **19**, No. 4, 516.

[7] Mathot. *Bull. Mat. Graisses*, 1921, Nos. 7 and 8, 116.

[8] *Facts about Sugar*, 1922, **14**, No. 21, 419.

Review of Current Technical Literature.[1]

YIELD OF GRANULATED SUGAR WHEN REFINING WITH DECOLORIZING CARBON ("NORIT") AS COMPARED WITH ANIMAL CHARCOAL (BONEBLACK) PRACTICE. *W. H. Dunstone, Jr. and B. Sandmann.* *Facts about Sugar, 1922, 14, 374-375 ; 15, 75.*

One of the arguments against the use of decolorizing carbons is to the effect that they do not adsorb the salts from the syrup to the extent that char does, so that a low yield of granulated and a molasses of high purity result. COATES recently stated[2] that 25 per cent. more molasses is produced in vegetable carbon refining as compared with bonechar practice; and HORNE gave as his estimate 50 per cent.[3] Replying to the statement regarding the small amount of salts adsorbed by decolorizing carbons, the authors point out that it contains some truth; but that it does not actually summarize the position. It is agreed that the adsorption of salts is more in the case of the animal charcoal, but this retention of melassigenic substances is only temporary, since when the char filter is sweetened off the salts readily go into solution in the sweet-water, which for this reason cannot as a whole be used for the re-melting of washed sugars. In practice therefore the sweet-water over a certain purity is usually evaporated to a syrup, which is mixed with other sugars, and boiled in a vacuum pan to a massecuite which must necessarily give a rather low yield of sugar; so that the net result is that the previous gain is entirely obliterated. On the other hand, vegetable carbons like "Norit" adsorb less salts, but rather tenaciously retain them even after washing with hot water, the consequence being that after a couple of weeks' use the ash may rise from 4 to about 18 per cent., iron salts in particular being thus removed from the liquors. It follows that the sweet-waters used for washing these carbons are of high purity, and can be used for the re-melting of the washed or affined crystals. In decolorizing carbon work the raw sugar is washed to a higher purity (say 99·0°) than in char practice (say 98·5°), necessitating more water, and producing more affination syrup; but this is not as great a disadvantage as the large amount of sweet-water to be treated in the char plant. This volume of sweet-water is comparatively considerable, owing to the large amount of char that must be used (50,100 and even 125 per cent.), as contrasted with the small amount of decolorizing carbon (about 2 per cent.) to produce the same effect. All the sweet-water produced in a "Norit" refinery is not even large enough to dissolve the sugar in the blow-ups. Then another point to be remembered in considering the yield is that in using "Norit" the losses are less than in char work, since generally no preliminary filtration is followed, the liquor being only strained, and not passed through cloth. Summing up, the authors state that on a basis of 96° raw sugar, the yield of granulated using "Norit" has been shown in large scale practice to be 93·3 per cent., a figure as good as that realized in well-conducted char houses.

USE OF DECOLORIZING CARBON ("CARBROX") IN THE REFINERY AS A PRELIMINARY CLARIFYING MATERIAL, AND ALSO IN THE MANUFACTURE OF WHITE SUGAR ON THE PLANTATION. *C. J. Gambel.* *La. Planter, 1922, 69, No. 9, 141.*

During the past three years the Henderson Refinery, New Orleans, has been steadily working toward the development of an economical system of applying decolorizing carbon, "Carbrox," or the material made from rice hulls[4] being the particular grade concerned. It was used more as a preliminary clarifying agent than as a decolorizer, insufficient being added to remove all the colour. Even in very small quantities, it took out large amounts of "gums" and other impurities, rendering the subsequent operations in refining much more easy. This line of investigation suggested possibilities of applying the carbon in plantation white manufacture, where larger amounts of impurities have to be eliminated. It was discovered that the addition of ¾ lb. of "carbrox" to the juice from a ton of cane would give surprising results, viz., (1) Removal of about 75 per cent. of the colouring matter; (2) elimination of a large proportion of gums and impurities, raising the purity of the juice and decreasing its viscosity; (3) reduction of the viscosity of juices, whereby incrustations are reduced, and strikes are boiled more rapidly in vacuum pans; (4) increase of the purity, more first sugars and more total sugars being secured. The carbon is added to the raw juice, and agitated in the liming tanks, and removed by subsiding, no special filters or extra equipment being used, so that the cost of the entire process is simply the cost of the carbons. Furthermore (it is claimed) the carbon treatment removes a sufficient amount of colour to replace the sulphitation treatment, so generally used. It will therefore be seen that this process really makes it possible for any modern factory to use "Carbrox" or other vegetable carbons without investing in any considerable amount of new machinery or equipment.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*

[2] *Facts about Sugar*, 1922, 14, No. 19, 372.

[3] *Ibid*

[4] *I.S.J.*, 1917, 577; 1919, 90; 1919, 249.

CENTRIFUGAL CLARIFICATION, USING THE RESINES MACHINE. *Anon.* *Facts about Sugar, 1922, 15, No. 3, 56-59.*

When in the centrifugal separation a liquid flows into a rotating basket, it takes the form of a vertical ring, limited in thickness by the inward projection of the basket top, the settling force caused by the rotation acting in a direction perpendicular to the depth of the liquid. On admitting an additional amount of liquid to the filled basket, it is nearer to the axis of rotation than any of the liquid already present. As the centrifugal force is directly proportional to the radius, all the liquid previously present is subjected to a greater centrifugal force than the new lot of liquid, which in consequence remains at the top of the ring of liquid, being discharged at the top before the centrifugal force has had the opportunity to effect a proper separation. This action in fact is analogous to that occurring in an ordinary settling tank, in which continuous operation is hindered by the fact that any additional liquid on being admitted to the tank travels along the surface and flows to the outlet without displacing any of the liquid previously present. On the other hand, continuous action is favoured in the *bac portal* used in Mauritius, in which by means of suitable baffle plates the juice is caused to take a long sinuous course up and down through the depth of the tank; and if the rate of flow is not too fast a fairly clean liquid results. Now the Resines centrifugal separator[1] operates on this principle, additional quantities after the basket is filled being obliged to travel a sinuous path until discharged. During the time of this travel the centrifugal force acts on the liquid and suspended solids in the ratio of their respective specific gravities, and the time during which the liquid remains in the machine can be regulated by merely controlling the inflow until the outflow is free of suspended matter. A 40 in. Resines machine holds when filled 60 gallons of liquid, but about two-thirds of this volume constitute a sedimentation chamber, which gradually becomes filled with suspended matter, the actual capacity of the apparatus being thus about 20 gallons. If the rate of flow is 30 gallons per min., it is evident that each drop of liquid remains in the basket for a period of 40 secs., during which time it will have traversed a helical course of a considerable distance, being subjected to a force from 500 to 600 times greater than gravity. A battery of four of these clarifying machines was installed in a sugar factory grinding 1000 tons per day; and although both the capacity and the motive power were insufficient, remarkable results are stated to have been obtained.

INFLUENCE OF THE PURITY OF THE JUICE UPON THE QUANTITY OF MOLASSES PRODUCED. *E. C. Zitkowski.* *Sugar News, 1922, 3, No. 5, 201-202.*

With the object of impressing upon Philippine planters the importance of delivering cane of good quality the author of this paper has calculated the available sugar and the quantity of molasses possible when the purity of the juices is 90, 70 and 60°, the following values being the same in each case: cane ground, 185,000 tons; weight of juice, 180,000 tons; polarization of the juice, 13·5; purity of the molasses, 30°; Brix of molasses, 90; and polarization of the the molasses 27, the following being the figures obtained:—

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[1] *I.S.J.*, 1921, 92-93.

	90°	70°	60°
Available sucrose, per cent.	96·3	82·54	72·22
Available sucrose, tons	23,401	20,057	17,549
Available 76° sugar, tons	24,376	20,893	18,281
Sucrose lost in the molasses, tons	899·1	4,243	6,750
Molasses produced, tons	3,300	15,714	25,002
Molasses, gallon per ton of cane	3·19	15·22	24·21
Molasses, gallon per ton of sugar	24·26	134·78	245·37

It is therefore seen from these figures that the volume of molasses produced from juice of 70° purity is about five times that resulting when juice of 90° is worked. If one were to work up juice at 60° purity, then compared with juice at 90°, no less than eight times the amount of molasses would be obtained.

SYSTEM OF PAYING THE PLANTER FOR HIS CANE ADOPTED BY THE PLANTATION UITVLUGT, DEMERARA. *E. C. Freeland. La. Planter, 1922, 68, No. 24, 384.*

At the Plantation Uitvlugt there are about 30 planters cultivating cane on land belonging to the estate, which charges no rent, pays taxes, supplies cane tops, helps with advances of money, manures the fields, and finally transports the cane to the factory in punts. Cane delivered to the factory is paid for on a basis of 50 per cent. of the amount of commercial sugar manufactured from it, no molasses being given, and the farmers may be paid in sugar or in money, according to the market value of this product. In calculating the commercial sugar due to the planter, the juice from each lot of cane is measured, sampled and analysed in order to obtain the sucrose content of the juice. Then the total lbs. of sucrose × recovery factor = lbs. of commercial sugar recovered.

This recovery factor $= \dfrac{J\,(S-M)^{*}}{S\,(J-M)} \times \dfrac{\text{Boiling house efficiency number}}{\text{Polarization of sugar.}}$

The boiling house efficiency number is the average percentage of sucrose recovered on the total percentage of available sucrose and is equal to:

$$\frac{\text{Sucrose in sugar percentage sucrose in juice.}}{\text{Percentage available sucrose in juice.}}$$

The available sucrose is calculated according to the above available sucrose formula. Inasmuch as the second massecuite produced on this plantation is stored for several weeks, the purity of the second molasses from the farmers' cane cannot be determined directly, and hence the value used for M is the average purity of the second molasses produced on the estate. The value of S remains almost constant, as a standard grade of raw sugar is produced; so that only two variable quantities (recovery factor and purity of juice) appear in the equation. By plotting a curve, using the recovery factors as ordinates, and the juice purities as abscissae, the average amount of sugar recovered from juice of a given purity can be determined very quickly. This recovery factor represents average factory work, and hence the values given by this curve are fair both to the farmer and to the estate. The average yield of commercial sugar per acre in Demerara is about two tons, so that the farmer usually receives one ton of sugar per acre cultivated.

NOVELTY OF THE SIMULTANEOUS CARBONATATION PROCESSES OF URBAN AND OF ANDRLIK AND KOHN. (1) *Zdenek Vytopil. Zeitsch. Zuckerind. cecho-slov. Republik, 1922, 46 (iii), No. 37, 451-453.* (2) *Karl Urban. Ibid., 1922, 46 (iii), No. 39, 470-472.*

(1) Two carbonatation processes in which the addition of alkali and acid are operated simultaneously have recently been published, one by URBAN[1], and the other by ANDRLIK AND KOHN[2]; and as the principle of both at first consideration appears very similar, it is of interest to study the question of novelty. Points of similarity are that both are for the

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* Noël Deerr's available sugar formula, where J, S and M are the purities of the juice, sugar and molasses, respectively.

[1] *I.S.J.*, 1922, 326. [2] *I.S.J.*, 1922, 270, 327.

purification of juices, syrups, and centrifugal run-offs or molasses; that both use oxides of the alkali earths: and that both precipitate these oxides or hydroxides by the addition of acid salts. Though URBAN does not mention the precipitation of the lime with magnesium bicarbonate, as do ANDRLIK and KOHN, yet he uses other acid salts, as those formed by sulphurous and phosphoric acids. Points of difference are that ANDRLIK and KOHN work with dolomitic lime from which they prepare magnesium bicarbonate; while URBAN, though he does not mention dolomitic lime or limestone, describes an experiment in which he applies a mixture of lime and magnesia in the proportion of 2:1, which is about the same ratio as that in which these constituents occur in dolomitic lime. Urban's method includes the separation of lime by all suitable acids and acid salts; so that, though he does not mention magnesium bicarbonate, it also may be included. Hence it may be accepted that the simultaneous carbonatation process of ANDRLIK and KOHN is only a special case of the method described by URBAN. Furthermore, the question arises whether this simultaneous carbonatation is new, for in Horsin-Déon's book[1] it will be seen that in dealing with the carbonatation of thick-juice the French *savant* spoke of "adding milk-of-lime in thin streams and at the same time passing in carbon dioxide." It follows therefore that the basic idea of both processes is similar, and has long been known; and that protection can be granted only to a certain manner of carrying out this idea provided a new and useful result constituting a technical improvement is realized. (2) URBAN replies to these remarks by asserting that a new and useful result certainly is produced by his process, because a considerable purification of the molasses is thereby effected[2]; whereas it appears that no other method has yielded any appreciable improvement of the purity so far as the molasses is concerned, a statement that is borne out by CLAASSEN in his book.[3]

SEPARATION PREVIOUS TO CARBONATATION OF THE PRECIPITATE PRODUCED BY THE LIMING OF BEET JUICE. *V. Skola. Zeitsch. Zuckerind. cecho-slov. Republik, 1922, 46, 601-611, 625-929.*

The precipitate produced on adding lime to beet juice and heating contains a fair content of albuminoid nitrogen, which may very well find use in cattle food manufacture or for some other purpose; but the many attempts which have been made to separate it economically in as pure a state as possible (that is, previous to the operation of carbonatation) have not proved successful hitherto.[4] At the instigation of Prof. ANDRLIK, the author has carried out laboratory experiments to observe the optimum conditions under which the separation of this precipitate is most likely to be realized by subsiding; and the more important of his results may be summarized as follows: Generally subsiding was very irregular, and it was seen that the rate at which the precipitate settled out was not dependent solely on the amount of lime, but largely upon the form in which this reagent is added (whether as solid or milk), and also upon the manner in which the addition was made. On the whole, the best results in respect of rapidity of subsiding were obtained by running the diffusion juice into milk-of-lime while constantly stirring, and under these conditions when using 1 per cent. CaO, about 0·2 per cent. CaO was retained by the precipitate. Less favourable results were obtained when about 0·2 per cent. in the form of milk-of-lime was added to the juice and mixture heated to 80°C.

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[1] "Traité de la Fabrication du Sucre," 1882, page 144.

[2] Figures were published by URBAN showing that his process yields remarkable results in respect of the improvement of purity, and decrease of colour, ash and lime content. But the point of practical importance is that particularly large amounts of lime are required to produce these effects.—EDITORS, *I.S J.*

[3] On page 268 of the fourth German edition of his book, this technologist when discussing the effect on centrifugal run-offs of saturation with sulphurous acid followed by filtration remarks that an increase of the purity by this treatment has never been proved. Later, on page 270, when dealing with other methods of purifying run-offs, he says that no practical result in respect of the precipitation of non-sugars by the use of barium compounds, hydrosulphurous acid, ozone, or the electric current, has yet been established.—EDITOR, *I.S.J.*

[4] *I.S.J.*, 1922, 379.

Review of Current Technical Literature.

Rate of Decomposition by Lime of some Nitrogenous Constituents of Beet Juice. *J. Vondrak. Zeitsch. Zuckerind. cecho-slov. Republik, 1922, 46, 483-490, 533-539, 589-598.*

A difficulty with which the beet sugar manufacture has often to contend (especially after a particularly dry summer) is the retrogression of the alkalinity during evaporation and boiling, so that a juice may finally become acid by the time it reaches the state of syrup, this condition of affairs being caused by the decomposition of the amides (principally asparagin and glutamin) as the result of heating in the alkaline medium, the corresing acids (aspartic and glutamic) being formed, and ammonia at the same time evolved. With the object of learning something more of the conditions under which this decomposition takes place in the factory during clarification, the author has studied the behaviour of aqueous solutions of the amides when heated with lime, and has arrived at the following conclusions as the result of his laboratory experiments: Asparagin on being heated with lime in aqueous solution is decomposed with the evolution of ammonia, and from the amount of ammonia produced it can be shown that this decomposition is of the nature of a unimolecular reaction. It proceeds more rapidly if the aqueous solution at the same time contains sugar; and the rate of the reaction increases with the temperature and in a certain degree also with the amount of lime added. In the presence of comparatively large amounts of amides, the rate of decomposition is slower than when their proportion is small, which may explain the marked diminution of the alkalinity that has been noted to occur when after a dry summer the amide content of the root is always quite high. A point of practical importance observed is that a more intense decomposition results when lime is added in the cold to the amide solution, which is then heated, than when it is added to the heated solution; and it is suggested as an advantageous procedure that in the factory the lime should be added to the cold juice, which subsequently should be heated and carbonated. As a means of preventing the diminution of alkalinity during evaporation and boiling, it is recommended that some lime should be added before the second carbonatation, and that the subsequent saturation with carbon dioxide should be operated at 100°C. Regarding the relative behaviour of the various amides to lime on heating in solution, glutamin is very easily decomposed; asparagin more slowly; and cholin and allantoin quite inappreciably.

Extraction of Sugar from Beet Molasses by a Modification of the Baryta Process. *H. Manoury. Bulletin de l'Association des Chimistes de Sucrerie de France, 1922, 39, No. 10, 413-421.*

An account is given of the method of working stated to be in routine operation in a factory in Spain. Barium sulphate intimately mixed with charcoal (both in fine powder) is heated in a reverberatory furnace at a temperature of 1000-1200°C., the sulphide being thus formed. After this product has cooled, it is treated with hot water in mixers provided with a stirring gear and heating coils, the final exhaustion of the residue being carried out in filter-presses. A liquor containing both barium hydroxide and barium sulphide in solution thus results, and it is treated with zinc oxide and heated, zinc sulphide being thus precipitated. This mixture is filter-pressed, the filtrate being a solution of barium hydroxide, which goes to precipitating tanks, into which is also run a definite amount of molasses. While constantly stirring, the mixture is heated to boiling-point, and maintained at that temperature for about 10 mins., at the end of which time the liquor is pumped through filter-presses, the barium mono-saccharate retained being subsequently washed with weak baryta water. Now the saccharate cake is decomposed, and for this purpose it is heated with a solution of zinc sulphate while stirring well, barium sulphate and zinc hydroxide being thrown out of solution.[1] Lastly, this insoluble matter is separated in filter-presses, and a solution of pure sugar is thus obtained.

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[1] This is a process which seems to be not unattended with the danger of contaminating the juice with zinc sulphate, if this reagent in the hands of a careless workman were added in excess. There is also the question to be proved whether zinc hydroxide is not slightly soluble in sugar solution under the conditions of working here described.—Editors, *I.S.J.*

Coming to the recovery of the by-products of his process, this inventor takes the zinc sulphide resulting from the decomposition of the barium sulphide, treats it with sulphuric acid, and thus obtains zinc sulphate, which he uses for the decomposition of the saccharate cake. Then the mixture of barium sulphate and zinc hydroxide from the decomposition of this cake is mixed with the wash-waters from the process of lixiviating the mixture of barium sulphide and barium hydroxide, the result being a solution of barium hydroxide, which is used for the preparation of the barium mono-saccharate, and a mixture of zinc sulphide and barium sulphate. This mixture (a good white lithophone) is treated with sulphuric acid for the formation of zinc sulphate, which is used for the decomposition of the saccharate cake, the barium sulphate, which goes back to the first part of the process, namely admixture with carbon and calcination in the reverberatory furnace.

CLARIFICATION OF BEET JUICES BY MEANS OF MAGNESIA, INSTEAD OF LIME. *G. Bruhns. Zeitsch. Zuckerind. cecho. slov. Republik, 1922, 46, (iii), No. 45, 613-621.*

An account is given of experiments carried out by Dr. FRÖLICH in 1889-90, at the Tapiau and Wendessen beet factories, using for the clarification of the juice magnesia made from magnesite deposits occurring locally. It was concluded that, although the results obtained were not unsatisfactory in respect of purity and colour, they showed no marked advantage as compared with those obtained with ordinary lime, while working was somewhat more costly.

INFLUENCE OF THE NON-SUGARS OF CANE JUICE OR SYRUP IN INHIBITING INVERSION. *C. Lourens. Archief, 1922, 30, No. 31, 562-564.*

Commenting on Mr. Van Ligten's recent paper on this subject,[1] the author accepts the conclusion drawn, namely that molasses is capable of preventing or at any rate hindering the inversion of sucrose by H-ions, either at low or at high temperatures. This appears to be borne out in factory practice, for one knows that it is possible to maintain evaporator syrup for some time at a high temperature say up to 60–65°C. without the purity appreciably diminishing, even after this product has been sulphited to 1 grm. of SO_2 per litre; while, on the other hand, the refiner working with liquors of higher purity is very careful at all times to avoid any such acidity as that habitually carried by the white sugar manufacturer. However, one has the impression from Mr. Van Ligten's article that the favourable effect of the addition of molasses in preventing or hindering inversion is due wholly or mainly to the amino-acids which are present in it. This may not be so. A more likely explanation is that when the molasses is treated with sulphurous or hydrochloric acid the organic acid salts are decomposed, and the organic acid (which does not readily dissociate, and has a low inverting power) is liberated. Rapidity of inversion stands in direct proportion to the H-ion concentration, and since under the circumstances explained the H-ions combine with the acid-ions to form a slightly dissociable acid, it means that a good number of the H-ions are withdrawn from the sphere of action. In fact in the presence of molasses quite another $_pH$ (H-ion concentration) is found than if one had to do with a pure or comparatively pure sucrose solution. Taking the inversion constant at 65°C. for HCl as 100, that for SO_2 is 40, and that of the organic acids liberated from molasses in the manner indicated is only about 0·50. In general, it may be accepted that any substance in molasses which is capable of acting with the strong acid added has the effect of lowering the H-ion concentration that would otherwise exist, which substance thus acts as a protector against inversion

"L'INTEGRALE," A NEW PUMP FOR THE SUGAR INDUSTRY. *J. A. Maronier. Archief, 1922, 30, No. 11, 173-178.*

SOLUBILITY OF DEXTROSE IN WATER. *R. F. Jackson and Clara G. Silsbee. Scientific Papers of the Bureau of the Standards, No. 437.*

REFRACTOMETER OF THE ABBE TYPE. *William Taylor. United Kingdom Patent, 178,290.*[2]

J. P. O.

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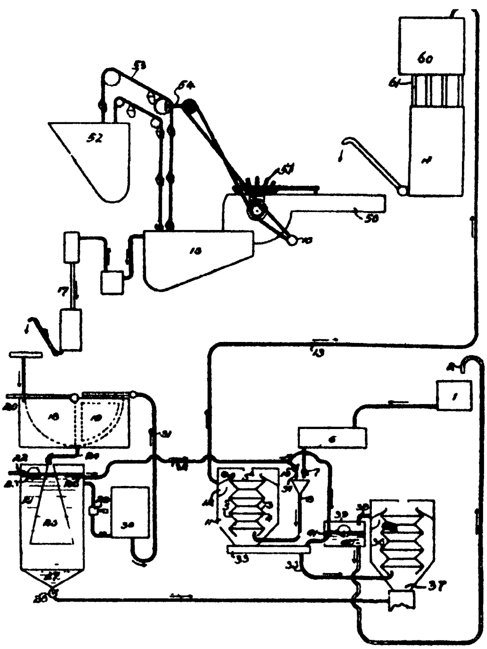
[1] *I.S.J.*, 1922, 439. [2] *I.S.J.*, 1922, 442.

Review of Recent Patents.[1]

UNITED KINGDOM.

Treatment of Cane Juice. *Wilhelm Mauss*, of Johannesburg, Union of South Africa. *182,855*. March 8th, 1921. (One drawing; ten claims.)

Mechanical impurities are removed first, preferably in a centrifugal machine, the clean juice then being treated by sulphitation, liming, heating, and filtration. Referring to the diagram, *1* indicates the mill, the maceration water being supplied by the pipe *2*. For the centrifugal separation of the solid impurities there is employed a battery of centrifugals, preferably of the kind described in Applications Nos. 164,418[2] and 182,856.[3] One such decanter is shown and comprises a rotating drum formed of several sections *3* separable on the planes *4* and providing a plurality of V-shaped depositing chambers *5*, *5*ᵃ. The drum is kept continuously rotating at its working speed. The green juice is fed from a supply tank *6* by way of a valve *7* and a pipe *8* into the lower end of the decanter and fills the chambers *5*, *5*ᵃ. The centrifugal force causes the mechanical impurities to settle in the chambers *5*, *5*ᵃ, whilst the cleansed juice flows away from the top to a receiver *9*. A special feature of this decanter is that the impurities settle in succession in the chambers *5*, *5*ᵃ from the bottom upwards; and the inflow of juice is stopped by closing valve *7* before the upper chamber *5*ᵃ is full, so ensuring that no dirt is allowed to overflow with the clean juice. At this stage the deposit in the chambers *5*, *5*ᵃ is washed by water admitted to the pipe *8* from the valve *10*, whereby a large proportion of the juice remaining in the decanter is displaced and recovered. The decanter is then discharged by separating its sections *3* without stopping the rotation (as described in Application No. 182,856). The dirt contained in the lower chambers *5* is discharged into a receiver *11*; the supply of wash water being continued during such discharge to assist the removal of the solid deposit. The contents of the uppermost chamber *5*ᵃ are, upon discharge, sampled by a sampling device *12*. After the decanter has been discharged, the supply of wash water is stopped by closing valve *10*, the decanter drum is closed again, and the supply of sugar juice is resumed.



The mechanically clean juice is now further treated to remove the chemical impurities consisting mainly of coagulatable albuminous matter. It will be assumed that the sulphitation process is to be applied. For this purpose the juice is conveyed by pipe *13* to a continuous sulphuring apparatus, consisting of an upper receiver *60*; a lower receiver *14* and tubular mixing devices *61* through which juice and sulphuring gas supplied to the receiver *60* pass down into the receiver *14* and are thereby mixed. The juice then passes to a continuous liming device. A suitable apparatus is characterized by continuous operation and the ability to adjust the amount of lime precisely so that the juice leaving this apparatus is exactly neutralized. In the apparatus shown the juice flows through a launder *50* into a tank *15* and in so doing rotates a bucket wheel *51*. A tank *52* contains a supply of lime-water which is fed to the tank *15* by the conveyor *53* geared to the bucket wheel *51*; the tank *52* being raised so that the conveyor is substantially self-acting and the bucket wheel *51* is not required to drive it. The speed ratio between the bucket wheel and the conveyor is adjustable by means of variable speed friction gear *54*. A counter *16* indicates and records the quantity of juice which passes through the system. The albuminous matter is now coagulated by elevating the temperature of the juice in a heater *17*; that shown being of the construction described in Application No. 173,709.[1] The coagulated juice is now passed to a vacuum filter *18*, which is conveniently of the kind described in Applications No. 176,395[2] and No. 181,123,[3] said apparatus being specially designed to treat the juice without agitation so as to avoid disintegration of the flocculated albumen. The finally purified juice which passes from the filter leaves *19* is now conveyed by a pipe *20* to the evaporators where it is converted into sugar in the ordinary way. Water is used in the vacuum filter for stripping the gelatinous cake from the leaves, and such water carrying the albuminous matter and a percentage of sucrose is conveyed to the tank *21*. Here it is diluted to assist its settlement and to recover sucrose from it. In order to recover as much sucrose as possible, the whole of the maceration water required at the mill may be added at this point. The fresh water is supplied through a valve *22* controlled by a float *23* which causes water to be admitted whenever the level in the tank *21* falls. The pipe *24* from the wash tank of the filter *18* opens into the top of a cone *25* fitted within the tank. The wash water passes downwardly within the cone and up outside the same to the water outlet *26* from the tank. Its speed accordingly constantly decreases, which assists the precipitation of the albuminous matter into the conical bottom *27* of the tank. Thence said matter is drawn off continuously or periodically through a valve *28*, and its sucrose contents being now small it is discharged from the system. At the upper part of the tank *21* there is shown the connexion of a pump *29* which takes water from the tank and forces it under high pressure to an accumulator *30*. From the accumulator such high-pressure water is periodically taken by pipe *31* for the purpose of stripping the gelatinous cake from the leaves of the filter, as described in Application No. 181,123, and after use returns again to the tank *21* by the pipe *24*. The water from the outlet *26* is carried by a pipe *32* to a receiver *33* into which also the solid matter and wash water from the primary decanter *3* is discharged. The matter discharged from the primary decanter is thereby further diluted and its sucrose contents reduced. A branch pipe *34* is taken off to supply said wash water, the control cock *10* in this branch being preferably actuated automatically with the decanter *3*, as described in Application No. 182,856. The contents of the receiver *33* consisting of the solid impurities from the juice and the wash water containing some sucrose, are treated to separate the bulk of the water. Accordingly, they are conveyed by a pipe *35* to a secondary centrifugal *36* which is preferably identical in construction and operation with the primary decanter *3*. The mud is discharged at *37* and the clarified water passes by a pipe *38* to a storage reservoir *39*. Thence it is withdrawn by the pipe *2* as required for use as maceration water in the mill, so that no sucrose passes out of the system except to the evaporators and the unavoidable small quantity in the solid residues discharged at *28* and *37*. In the storage reservoir *39* is a float *40* controlling a valve *41* on the pipe *32*. When maceration water is being taken for the mill, the float *40* falls and opens the valve *41* to replenish the storage reservoir *39*. When the reservoir is full the valve *41* is closed, stopping the flow of water from the tank *21* except that used for washing the primary decanter *3* and discharging solid from the tank *21* at point *28*; the float *23* correspondingly controlling the inflow of fresh water to the tank *21*.

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[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2fr. 00 each).

[2] *I.S.J.*, 1921, 592.

[3] Not yet published.

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[1] *I.S.J.*, 1922, 220. [2] *I.S.J.*, 1922, 328. [3] *I.S.J.*, 1922, 497.

Rotary Filter.[1] *Henry A. Vallez,* of Bay City, Mich, U.S.A. *181,879.* April 6th, 1921.

A rotary filter is described of the kind having a cylindrical casing and a set of filtering bodies rotatably disposed within said casing, including a channel or discharge passage in the casing, characterized in that said channel is provided with a discharge opening at a point midway between the ends of the entire set of filtering bodies. Further, the filter includes a finger movably disposed in the interior of the casing and adapted to contact with a surface of one of the filtering bodies, whereby through the collection of sediment on said surface said finger is gradually moved, and an indicator connected with the finger and disposed on the outside of the casing to show the increase of the thickness of the cake on the filtering body. Means are also provided for limiting the movement of the indicating elements of the finger so as to show when a predetermined thickness of cake has been collected. Lastly, the filter is provided with a hollow shaft connected with a pipe and valve, by means of which a rinsing liquid under pressure may be introduced either on the filter discs or through the hollow shaft, or also both on the filters and through the shaft simultaneously.

FIG 2

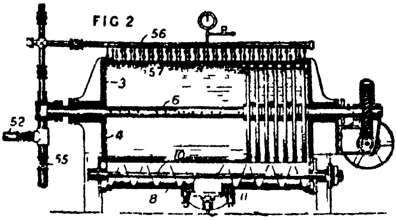


FIG 4

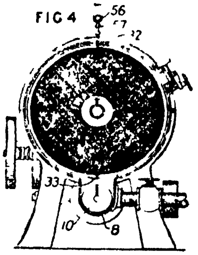


FIG 9

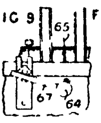
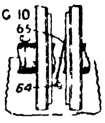


FIG 10



Turning to the drawings, it is seen that the cylindrical casing containing rotary disc filter elements has at the bottom a channel to receive the separated solid matter and the channel is provided with a discharge opening at a point midway between the ends of the set of filter elements. The elements are mounted on a hollow shaft *6* in a casing formed of upper and lower sections *3*, *4*. Each element comprises a metal frame with projections and drainage recesses and having a perforated plate and a filter cloth or gauze fixed on each side. Passages in the hub of each element register with apertures in the shaft *6* and allow the filtered liquid to pass from the drainage recesses to the outlet pipe *52*. The thickness of the cakes formed is indicated by a finger *65*, Figs *9* and *10*, resting against one of the cakes and turning a shaft *64* which passes through the casing and has an indicating arm *67*. Water for washing the cakes is supplied from a main *56* through branches *57*, and the solution obtained filters into the elements and is discharged through a pipe *55*. The cakes are removed from the elements by steam, water or compressed air sprayed through the pipes *57*, two of which are provided between each pair of elements. The solid matter falls into a channel *8* and is directed by a combined right and left-hand helical conveyor *10* to an opening normally closed by a plate *11*. Solid matter adhering to the casing is detached by longitudinal scraper bars *32*, *33* fixed to the elements. Inlet pipes for the material to be treated are connected to the side of the channel *8*. The upper section of the casing is provided with doors at one side.

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[1] This appears an interesting rotary filter. It has been stated that in certain beet factories in the U.S.A , whereas formerly 1 foreman and 12 men were required for a filter-press installation, when the Vallez was installed 1 foreman and 3 helpers only were necessary. Cloth consumption was much reduced, and in the Columbia Sugar Co.'s plant at Bay City, Mich , the cloth used was reduced from 16,000 to 3500 yards for a campaign of 111,000 tons of roots. Furthermore, working with this apparatus should be reasonably cleanly and without escape of steam. The makers claim that a refinery melting 3½ million lbs. of raws in 24 hours will not use over 8 men per shift for the entire Vallez installation ; though they do not state the filtering surface that would be required for a house of this capacity. In the application of decolorizing carbon the filter has given good results, when the cake was built up on a matte of paper pulp. The use of cloth over the perforated monel metal screen can be dispensed with, and even the finest particles can be thus separated with certainty.—Ed., *I.S.J.*

UNITED STATES.

FILTER-PRESS, CAPABLE OF READY OPENING AND CLOSING. *Alfred Burger*, of Brooklyn, New York, U.S A. *1,409,281*. March 14th, 1922.

It is the object of this invention to provide means whereby a filter-press can be opened or closed with greater facility than is now possible, so that the entire operation, including the application of the required pressure, can be accomplished, even in presses of large size, by one man. In accordance with the invention the worm gear is fixed on the screw shaft and is operated by a worm which is so mounted as to be capable of moving with the worm gear in the direction of movement of the screw shaft, while it is held from revolution about the screw shaft, provision being also made whereby the worm can be disengaged readily from the worm gear to permit the screw shaft to be moved rapidly when pressure is not being applied through it to the filter plates or frames. Claim 3 is: The combination of main frames, a movable head mounted thereon, a non-rotating nut, a fixed nut-supporting member, a screw shaft mounted in the nut-supporting member, engaging the non-rotating nut, a worm geat fixed on the screw shaft, a casing, a worm shaft supported in the casing in engagement with the worm gear, a means to prevent revolution of the casing and worm shaft about the screw shaft while permitting the casing and worm shaft to move with the worm gear in the direction of the screw shaft, the casing having eccentrically mounted bearings to support the worm shaft and to permit the same to be moved into and out of engagement with the worm gear.

MOTOR FUEL CONTAINING ALCOHOL. *Arthur A. Backhaus* (assignor to *U.S. Industrial Alcohol Co.*). *1,419,910*. June 20th, 1922.

Claim 1: A fuel comprising a petroleum distillate, an alcohol, an aromatic hydrocarbon, and a phenol adapted to blend the other constituents.

CONTINUOUS CLARIFYING CENTRIFUGAL FOR SUGAR JUICES.[1] *Wilhelm Mauss* (assignor to *Continuous Centrifugal Separators Ltd.*, of Johannesburg, South Africa). *1,419,285*. June 13th, 1922.

VACUUM FILTER.[2] *Wilhelm Mauss* (assignor to *Continuous Centrifugal Separators Ltd.*, of Johannesburg, South Africa). *1,419,286*. June 13th, 1922.

MOTOR FUELS CONTAINING ALCOHOL. *Burnell R. Tunison* (assignor to *U.S. Industrial Alcohol Co.*, of New York). (1) *1,423,048*. (2) *1,423,049*. (3) *1,423,050*. July 18th, 1922.

(1) Claim 1: A liquid fuel which is more dense than kerosene, comprising a relatively heavy hydrocarbon of an aliphatic series and an alcohol. (2) Claim 1: A liquid fuel comprising a petroleum distillate heavier than kerosene and an ester of an organic acid and a monohydric alcohol, the heavy oil being present in the proportion of about three-quarters of the total mixture. (3) Claim 1: A liquid fuel consisting of a petroleum distillate heavier than kerosene and an aromatic hydrocarbon.

BEET TOPPERS. (1) *Asa H. Ballard*. *1,368,471*. February 15th, 1921. (2) *Sylvester C. Warner*. *1,423,374*. July 18th, 1922.

CENTRIFUGALS. (1) *Selden H. Hall* (assignor to *The De Laval Separator Co.*, of New York). *1,422,852*. July 18th, 1922. (3) *Cyrus H. Hapgood* (assignor to *The De Laval Separator Co.*, of New York). *1,422,856*. July 18th, 1922.

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[1] See also U.K. Patent, 164,418; *I.S.J.*, 1921, 592.

[2] See also U.K. Patent, 176,395; *I.S.J.*, 1922, 328.

HOLLAND.

Filling Sugar Moulds with Massecuite. *Heinrich Delvenne*, of Frankenthal, Germany. *6990.* August 4th, 1920.

An apparatus for the filling with massecuite of moulds, such as are used in the Adant process of cube sugar manufacture, is described, according to which the funnel is provided with a special closing device by means of which loss of material is obviated, labour is economized, and the whole operation is facilitated.

"Figured" Top Roller, or Shell for a Top Roller. *Naamlooze Vennootschap de Nederlandsch-Indische Industrie*, of The Hague, Holland. *4470.* December 15th, 1919.

This invention relates to the top roller, or the mantle, shell, or cylinder of the top roller of a cane mill of the kind in which the surface is divided by grooves or channels into figures. Such a roller fulfils two functions: (1) to grip the cane and draw it through the mill, and (2) to express the juice from the crushed cane, sharp corners being most suitable for the first, and flat surfaces for the second function. With surfaces of the kind mentioned, the edges of the grooves separating the figures also serve for the gripping of the stalks, and the surfaces of the isolated figures for their crushing. According to this invention, a number of figures on the surface itself are provided with grooves for the purpose of increasing the gripping power, both the grooved and the ungrooved figures being arranged in a certain manner over the surface so as to attain the most favourable combined effect possible. Top rollers having surfaces divided up into figures, in which these figures adjoin in the manner of the pieces composing a parquet floor, are known among others the "Diamond" top roller. However, the provision of grooved figures, and of the special alternation of grooved and ungrooved figures forming the characteristics of the present invention, are new elements by which as is shown in practice a better extraction and further a greater capacity (with the same power) are realized. In the illustrations, Fig. 1 represents a portion of the surface of the mantle in a flattened position, $X-X$ being the direction of the axis of the top roller; while Fig. 2 is a section on a larger scale across the line $Y-Y$ in Fig. 1. As is seen the surface is divided by grooves into a number of figures of like size, joined up to one another like the blocks of a parquet floor. With some of these figures A, the surface is left ungrooved; while in others B a groove C which runs lengthwise, and which is shallower than the groove D, is provided, two sharp edges or ribs being thus formed. If now one regards a row of parallel figures lying across the line $X-X$, then a grooved and an ungrooved figure is found alternately. The same holds for a row of parallel figures lying parallel to $X-X$; but it is not necessary in the same series that a grooved should alternate with an ungrooved figure, since the arrangement may also be such that after one ungrooved, two grooved figures may follow. It is only necessary that grooved and ungrooved figures should in a general way regularly interchange with each other. It then results that all cane stalks, no matter where they may enter the rollers, pass over the surface of the "figured" mantle under the same conditions, which explains the improved operations of the top roller according to this invention.

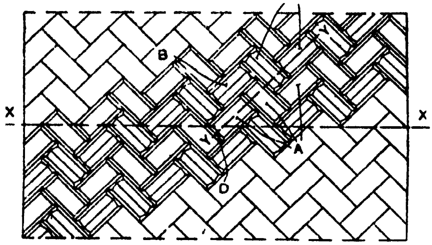

FIG. 1.

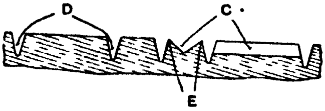

FIG 2.

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	One Month ending September 30th.		Nine Months ending September 30th.	
Unrefined Sugars.	1921. Tons.	1922. Tons.	1921. Tons.	1922. Tons.
Poland	....	...	5,641	....
Germany	....	41		60
Netherlands	....	....	398	....
Belgium	....	....	....	...
France	....	....	....	....
Czecho-Slovakia		....	. .	....
Java	445	48,037	24,204	57,022
Philippine Islands	....	....	....	....
Cuba	63,509	22,922	202,584	618,673
Dutch Guiana	264	....	1,252	2,422
Hayti and San Domingo	....	....	....	....
Mexico	....	....	....	....
Peru	5,161	11,525	66,823	61,796
Brazil	6,121	3,785	50,618	70,617
Mauritius	1,717	3,811	182,068	106,458
British India	....	1,007	1,423	1,524
Straits Settlements	....	....	....	....
British West Indies, British Guiana & British Honduras	6,446	2,329	89,070	92,094
Other Countries	87	14,281	31,707	55,481
Total Raw Sugars	**83,741**	**107,238**	**655,789**	**1,066,146**
Refined Sugars.				
Germany	....	....	1	65
Netherlands	4,194	2,562	74,259	19,394
Belgium	19	245	16,112	3,261
France	....	574	3,057	593
Czecho-Slovakia	3,848	420	74,330	25,654
Java	1,335	7,867	1,689	8,318
United States of America	28,343	12,092	156,174	259,880
Argentine Republic	....	....	....	....
Mauritius	..	....	....	....
Other Countries	7,485	13,563	48,814	83,861
Total Refined Sugars	**45,225**	**37,323**	**374,437**	**401,028**
Molasses	8,213	10,534	66,903	80,423
Total Imports	**137,179**	**155,095**	**1,097,129**	**1,547,597**

EXPORTS.

British Refined Sugars.	Tons.	Tons.	Tons.	Tons.
Denmark	....	292	1	1,911
Netherlands	78	248	1,714	2,547
Channel Islands	71	51	1,085	860
Canada	....	....	....	3
Other Countries	274	922	2,165	21,165
	423	1,512	4,966	26,485
Foreign & Colonial Sugars.				
Refined and Candy	39	320	329	3,272
Unrefined	146	161	2,266	7,892
Various Mixed in Bond	....	....	....	....
Molasses	66	1,023	455	2,499
Total Exports	**674**	**3,016**	**8,016**	**40,148**

Weights calculated to the nearest ton.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1922. Tons.		1921. Tons.
Total Receipts, January 1st to September 27th	3,129,310	..	2,041,438
Deliveries ,, ,, ...	3,108,023	..	2,102,526
Meltings by Refiners ,, ,, ...	3,003,313	..	1,964,844
Exports of Refined ,, ,, ...	800,000	..	280,000
Importers' Stocks, September 27th	21,287	..	39,964
Total Stocks, September 27th..	127,752	..	117,153
	1921.		1920.
Total Consumption for twelve months	4,107,328	..	4,084,672

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1919-1920, 1920-1921, AND 1921-1922.

(Tons of 2,240 lbs.)	1919 20. Tons.		1920-21. Tons		1921-22 Tons.
Exports	3,130,357	..	1,898,821	..	3,235,393
Stocks	327,032	..	1,236,062	..	453,070
	3,457,389		3,134,883		3,688,463
Local Consumption	62,700	..	85,000	..	100,000
Receipts at Ports to August 31st	3,520,089		3,219,883		3,788,463

Havana, August 31st, 1922. J. GUMA.—L. MEJER.

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR NINE MONTHS ENDING SEPTEMBER 30TH, 1920, 1921, AND 1922.

	IMPORTS.					
	1920. Tons.		1921. Tons.		1922. Tons.
Refined......	119,514	..	374,437	..	401,028
Raw	920,353	..	655,789	..	1,066,146
Molasses	57,833		66,903	..	80,423
	1,097,700		1,097,129		1,547,597

	EXPORTS				
	1920. Tons.		1921. Tons.		1922 Tons.
Refined	2,800	..	329	..	3,272
Raw..	7,917	..	2,266	..	7,892
Molasses	2,766	..	455	..	2,499
	13,483		3,050		13,663

	HOME CONSUMPTION.				
	1920. Tons.		1921. Tons.		1922. Tons.
Refined	137,665	..	353,822	..	371,710
Refined (in Bond) in the United Kingdom	610,276	..	589,917	..	714,241
Raw	155,198	..	98,818	..	122,169
Total of Sugar	903,139		1,042,557		1,208,120
Molasses..	22,800	..	8.740	..	6,574
Molasses, manufactured (in Bond) in United Kingdom ..	56,574	..	34,222	..	38,317
	982,513		1,085,519		1,253,011

STOCKS IN BOND IN THE CUSTOMS WAREHOUSES OR ENTERED TO BE WAREHOUSED AT SEPTEMBER 30TH, 1920, 1921, AND 1922.

	1920. Tons.		1921. Tons.		1922. Tons.
Refined in Bond	22,950	..	35,000	.	51,550
Foreign Refined	42,350	..	47,200	.	36,100
,, Unrefined..	269,350	..	206,350	.	190,750
	334,650		288,550		278,400

Sugar Market Report.

Our last report was dated 7th September, 1922.

At that date the tendency was for values to decline, and trade buyers, both here and in America, with little to encourage them, had adopted a cautious attitude. Consequently the shrinkage continued and was expressed in the terminal market quotations of 19s. 10½d. Dec. and 20s. 3d. May at the weakest moment. More trade activity has been met in the past ten days, resulting in a recovery to 21s. Dec., 21s. 4½d. May, or practically to the level last reported Whilst watchful of New York, the terminal market shows little sign of speculative activity, responding but languidly to movements recorded from that side. Prices of London Refined are lower at 56s. for No. 1 Cubes and 50s. for London Granulated, as against 58s. 3d. and 51s. 3d. respectively. Good Belgian crystals, such as F.W., after being offered down to 18s. 7½d. f.o.b. Antwerp for Oct /Dec. are now quoted at about 19s. 4½d. White Javas of satisfactory quality have arrived in good quantity on July and August shipments, and near floating lots are held for 20s. 3d. c.i.f., spot being obtainable at 47s. 3d. to 47s. 6d. duty paid. American Granulated floating 22s. 3d. c.i.f., spot duty paid 49s. 3d. Recently some business has been reported in Superior No. 3 French Crystals for Oct. and Nov. f.o.b. North French ports at 19s., and Nov. c.i f. at 19s. 6d.; such sales being in connexion with export certificates granted to growers with certain conditions as to reimportation of similar quantities free of duty later in the campaign.

Towards the end of September, F. O. Licht published a tentative calculation of the European production, which showed an increase of about 770,000 tons over last year's crop. This figure included full allowance for the principal countries on the basis of their declared sowings, also an increase in Russia of 170,000 tons. The crops generally seem to be of good appearance but continued heavy rains, chiefly in Belgium and Czecho-Slovakia are said to be causing delay in harvesting. As these two countries are fairly heavily sold for New Crop, the early production is not likely to press unduly on the market. In Germany although the coming crop is expected to be 1,600,000 tons as against 1,300,000 tons last year, and probably sufficient to cover the consumption, efforts are still being made to regulate supplies by restricting the use of sugar for special luxury manufactures to imported parcels; and whereas it was generally expected that permission to import would be withdrawn at the end of September, apparently no action has so far been taken. Total imports into Germany this season are difficult to estimate, but 60/70,000 tons is generally accepted as being near the quantity.

The reduction in the Cuban Stock (at 7th October the stock was 316,000 tons against 1,185,000 tons last year) has been pointed to by some as a basis for the expectation of a considerable improvement in raw values. Certainly the figures are moving in the direction of older predictions of something below 250,000 tons at the end of this year; and 96° centrifugals after dipping temporarily to 3 c. c. & f. New York are now on the up grade, latest business reported being at 3⅝ c. & f.

The alteration in the American Tariff, in the meantime, makes the present duty on Cuban 96° 1·7648 c. as against 1·61 c. per lb. Whilst this has the effect of increasing the cost of raws to the American refiners, it is probably not sufficient to materially affect actual consumption. If the American consumption continues to take sugar off the market at anything like the rate maintained during the earlier part of the year, (which would indicate that the considerable invisible supply generally assumed to have been accumulated had either been overestimated or largely reduced during the recent period of slack trading), it looks as though prices of raws must trend further upwards to balance the "pull" upon the diminishing stocks. Of course the requirements of Europe, particularly the U.K. Refiners, are also a factor to be reckoned with, but the strength of the position is modified by the extent of supplies available from other sources.

Shipments from Java during September are estimated at about 230,000 tons, against 239,000 tons in September, 1921. The Trust have now disposed of the remainder of their holding of all kinds, but there is still a considerable stock in the hands of shippers and speculators to be marketed. There seems little prospect of India coming in as a buyer in the near future. To-day's quotation for White Javas c. & f. Calcutta is 20s. for Oct./Dec., with probably small lots obtainable from second-hands at 19s. 9d. Recent business to U.K. Refiners includes Brazils and Perus at 16s. to 17s. c.i.f. and No. 17 Javas up to 17s. 9d. c.i.f., and the present asking price for Cuba 96° is 18s. 6d.

H. H. Hancock & Co.

10 & 11, Mincing Lane,
London, E.C. 3,
12th October, 1922.

THE

INTERNATIONAL SUGAR JOURNAL.

No. 287. NOVEMBER, 1922. Vol. XXIV.

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot under take to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

Political Changes at Home.

In the four weeks between the issue of our October journal and the appearance of this number, a first class political crisis has developed in Great Britain, culminating in the holding of a general election which is bound to have momentous results for the immediate welfare of the country. It had been generally anticipated that very shortly Mr. Lloyd George would appeal to the country for renewed support for his Coalition Government, particularly in view of the danger of a Labour accession to power. But the Conservatives and Unionists who formed by far the largest section of the coalition had come to the conclusion that the time was ripe for the dissolution of the coalition form of government and the return to party government such as existed before the war. Their leaders, it is true, hesitated to take any step in that direction, partly owing to a sense of loyalty towards the Prime Minister with whom they had co-operated for so long, and partly from a belief that any dividing of the coalition forces might let Labour in to power with its anticipated programme of capital levies and class legislation. But the rank and file of the Unionist party evidently considered that the Labour danger was overrated and that an attempt should be made to get the country's consent to a return to a party Government before giving the Coalition a new lease of life. If the country showed by its votes that it did not give a clear majority to one party, then further coalition between the two most constitutional parties could be arranged. With this idea in view, a party meeting of the Unionist M.P.s defeated a proposal of their leaders that the Coalition of Mr. Lloyd George should be continued; Mr. Bonar Law who had been out of the Government for some months owing to illhealth gave a strong lead to the dissentients and the counter-proposal to return to party government was carried by a large majority. The result was that Mr. Lloyd George and his Coalition Government were forced to resign; and Mr. Bonar Law became Prime Minister and formed a new Cabinet, partly from ex-Cabinet Ministers and partly with new blood. It became necessary of course to make an appeal to the electors to confirm Mr. Bonar Law in power, even though his was the largest party in the House of Commons; so preparations for a General Election have occupied the attention of the country the last two weeks.

Since the poll is being held on the eve of our publication, and the results of the election will be known about the same time, it is futile discussing probabilities or chances here. If the country gives the Unionist party a clear majority over all other parties, well and good. If not, then it will rest with the best elements of the old coalition to form a working combination, either to carry on the Government or (in the unlikely event of Labour getting the largest single majority as a party) to prevent any extremist legislation being forced on the country.

But the danger of the perpetuation of the Coalition form of Government is that it tends to fix in the public mind the existence of only two parties in the State, Coalition and Labour; so that a dissatisfied electorate may deem the only alternative government to one of Mr. LLOYD GEORGE and his Coalition to be one of Labour. And nothing has recently occurred to suggest that Labour is yet ripe to govern. It contains undoubtedly some clever and levelheaded men, but it is still too much under the sway of a narrow-minded proletariat who would dictate policy to the leaders and be the real instigators of any Labour programme. The repeated extent to which trade union leaders have been overruled by their men in strike negotiations the last few years is still fresh in the public mind.

Undoubtedly what the saner element in the country wants is what Mr. BONAR LAW and his party offered it in their election address. "The crying need of the nation at this moment is that we should have tranquillity and stability both at home and abroad, so that free scope should be given to the initiative and enterprise of our citizens." The need is not for fresh experiments in legislation, but for setting the house in order so that trade and industry may revive with the minimum of delay. A reduction of expenditure with a view to alleviation in taxation was another plank in Mr. Bonar Law's appeal to the nation; and since he considered that the revival of trade could be best effected by developing our Empire, he proposed if confirmed in power to consult the governments of the self-governing Dominions and if they approved call an economic conference at an early date to go into the whole subject with a view to formulating a plan of trade co-operation within the Empire. The development of agriculture at home was also to form a leading feature of the new programme.

Till we know the verdict of the country it is useless enlarging on the merits of the Unionist Party programme; but it can at least be said that it strikes the right note and should appeal to all those who "think imperially"—not in any spirit of self-aggrandizement or aggressiveness, but simply in the belief that the general peace and prosperity of the world will be helped by a system of cordial co-operation in trade and diplomacy between the mother-country and the various portions of the Empire.

United Kingdom Sugar Consumption.

We received last month too late for comment the figures of the consumption of sugar within the United Kingdom for the last quarter. These showed that the July-September consumption was not at so high a rate as in the April-June quarter, the amounts being 423,217 tons and 434,480 tons respectively but comparing favourably with the 1921 figures of 384,390 and 323,805 tons respectively. On the average basis of the nine months' figures the consumption for the year should be not less than 1,610,828 tons. The April-June consumption was at the rate of 1,737,920 tons per annum and that of July-September at the rate of 1,692,868 tons; while if we take the consumption of the past six months as being the new standard, it betokens an annual consumption of over 1,700,000 tons. Either way we were justified in forecasting in our August issue that the pre-war figure, at least, of 1,750,000 tons for this country was in early prospect once more.

The British Sugar Beet Campaign.

The production of sugar from beet grown in the Midland and Eastern Counties has been taking place during the last six weeks at the Beet Sugar factory at Cantley in Norfolk, where all the crops grown in England on behalf of the two sugar companies are being worked this year. At the start, delivery of beets to the factory was very slow, but farmers are now sending forward their crops at a satisfactory rate. In spite of the unusually wet summer and lack of sunshine, the sugar content in the beets is very good, averaging to date about 16 per cent. This proves again that the climate and soil of England are suitable to this new agricultural industry. Sugar beet has been a profitable crop compared with other crops grown this year. That farmers are realizing its value is demonstrated by the fact that a large number of enquiries have already been received by the factories asking for an early indication of next year's price, so that land may now be reserved for this purpose.

Incidentally, the harvesting of the crop has brought employment to a large number of men, and 600 hands are engaged at the factory.

Financing Sugar Mills: A new Scheme.

We learn that a new Finance Corporation has been lately formed in Havana and New York for the purpose of aiding such sugar properties in Cuba which, while not under the control of the big banks, nevertheless require some financial assistance. Such factories are mostly quite good propositions and only want a little assistance in order to do well. The principal directors and officials of this Corporation are said to include a well-known Havana bank manager, one or two sugar brokers, a firm of sugar machinery manufacturers in the United States, and a financial house. When a mill asks for assistance, the Corporation will thoroughly investigate the proposition and if found satisfactory arrangements will be made to finance it, but of course on terms; these latter will probably stipulate that all sugars made by the mills shall be shipped to the Corporation and sold through the brokers who are members of it. All new machinery required will most naturally have to come from the manufacturing firm in the Corporation. In fact, the whole business of the mill may conceivably be controlled by this Corporation.

Of course, the degree in which this control will be exercised will depend on the extent to which the mill is financially assisted; but it is obvious that the plan diverts the orders for new machinery to a certain firm without competition, and assures payment of the machinery through the sale of the sugar. In any event, it is a fairly safe game to play; and if several more such corporations start operations in Cuba, most of the mills will end by being controlled in one way or another, which means that there will be small chance of the sugar machinery trade in general competing for Cuban orders. There is no forecasting at the moment how far the development will spread; but it is a movement that will need to be watched by all those interested in a free competitive market for sugar machinery.

American Exports of Refined Sugar.

According to a New York trade review, the total quantity of refined sugar exported from the United States during the first seven months of this year was greater than in any previous full year and was thirty times as much as in the year 1913-14. Prior to the war when Europe was producing all its own sugar requirements from beet, U.S. reports of refined sugar were extremely small, amounting in 1913 to only 26,000 short tons valued at less than two million dollars. In 1914 when war conditions prevailed the exports increased to 195,000 tons, in 1915 to 481,500 tons, in 1916 to 788,500 tons, while the exports were 505,500 tons in 1917, 737,500 tons in 1919, 500,000 tons in 1920 and a like amount in 1921. For 1922, estimating on the basis of the first seven months, the exports for the twelve months ending December 31st next may reach as much as 1,250,000 short tons. More than three-fourths of this large export is destined for Europe. During the seven months in question the amount exported to the United Kingdom was 281,000 tons (or roughly nearly one-sixth of the total consumption in this country), while France took 164,000 tons and Germany 52,000 tons.

It is clear that this new trade in Europe in American refined sugar (mostly Cuban sugar refined at Atlantic ports) is going to be a severe competitor with British and Continental refineries in supplying the now increasing consumption of the European countries. As far as Great Britain is concerned, it can be of no benefit to her to exchange her pre-war dependence on German and Austrian beet sugar for a like dependence on Cuban-American cane sugar. Her interests clearly lie in broadening the sources of her sugar supply, and whatever the result of the polling for a new British Government and Parliament now in process of completion, we trust the destinies of the country will fall into the hands of a party that will not be slow to realize that Empire development is a prime necessity if our supplies of food are not to be jeopardized either in peace or war by commercial or military combinations or cartels.

Opening of the West Indian Agricultural College.

The West Indian Agricultural College in its temporary quarters at St. Augustine, Trinidad, was opened on the 16th of October last by the Governor of Trinidad in the presence of a large gathering. Till the permanent college is built and equipped, the schools will be housed in temporary buildings, and a sum of £15,000 has already been expended in providing or improvising these, as well as in erecting housing accommodation for the teaching staff. Sir Francis Watts, K.C.M.G., D.Sc., who drops the rôle of the now defunct Imperial Commissioner of Agriculture for the post of Principal of the College (a position in which he will be able to carry out much of his previous good work) explained to the gathering the *raison d'etre* of the new college; he pointed out that existing agricultural colleges are mostly concerned with the agriculture of temperate climes, whereas in the study of tropical agriculture the student finds himself confronted with a great variety of problems that can only be met with and solved in the tropics themselves. Considering the part played in daily life and commerce by such things as sugar, cocoa, tea, cotton, rubber, etc., the importance to the Empire of tropical agriculture and its proper investigation becomes apparent. In the case of sugar for instance, Sir Francis Watts reminded his audience that there was no school or college in the British colonies where adequate instruction could be given in the science of sugar manufacture, hence all our skilled technicians have had to be drawn from the ranks of students who have been trained in foreign institutions. He however referred to an effort in this direction that had recently been started in Mauritius. It is widely felt that a British sugar school in a tropical colony provided with a model sugar factory in which the art of sugar making in its different phases can be taught, is indispensable; such teaching in the factory would of course supplement and complete the teaching in the classrooms and laboratories. It was at once obvious that the newly opened West

Indian Agricultural College would offer unrivalled opportunities for the establishment of such a school; and as a matter of fact, thanks to the generosity of the leading manufacturers of sugar machinery within the United Kingdom, all the principal machinery for a model sugar factory capable of turning out two tons of sugar per day has been promised and will be erected as soon as circumstances allow; funds for the cost of erecting the factory as well as for providing the cost of the teaching staff to operate it have yet to be obtained. SIR FRANCIS WATTS expressed the hope that the improved prospects of the sugar industry would assist in the early realization of this money, and that firms in the United Kingdom interested in sugar would contribute generously to the funds to enable the factory to be brought into existence at an early date and thus establish what should prove to be the finest research work sugar school in existence.

It may be added that in addition to SIR FRANCIS WATTS, the teaching staff consists of Professors H. A. BALLOU, M.Sc., F. S. DASH, B.S.A., S. F. ASHBY, B.Sc., F. HARDY, M.A., F. G. MASON, M.A., B.Sc., and W. R. DUNLOP.

Jamaican Affairs.

Elsewhere we give a succinct account of affairs in the sugar industry in Jamaica from the pen of a local correspondent. He shows that in spite of numerous drawbacks a normal crop of nearly 50,000 tons has been produced in the recognized factories. But the prices at which the sugar has been sold have been too low to bring in much profit and the cane farmers and labourers have had to be content with a rate of remuneration that has not been conducive to energy or perseverance. The discouragement experienced by the growers has indeed resulted in hundred of acres being put back again to bananas, so that only one of the sugar factories has been able to reach its estimated cane capacity for the crop.

One difficulty in Jamaica is the association of the rum industry with that of sugar production. In the old days imperfect modes of sugar manufacture were a natural preliminary to an output of very high grade rums; now with the advent of sugar centrals rums of very light body, low in ethers and not up to the standard of the old fashioned marks, are being increasingly produced. Unfortunately there is great difficulty in marketing them, in part owing to the prohibition laws in the United States, but also to the high duty on entry into the United Kingdom (£500 per puncheon) and the cost of conveyance there. The result is that rum is no longer a profitable business and the Jamaicans are getting nervous as to the future of the industry.

The annual Report of the Departure of Agriculture in Jamaica also dwells on the unsatisfactory state of the rum business, A good deal of the rum sold last season, it states, lies still unsold in English and Scottish bonded stores with small prospects of immediate sale owing to the high duty keeping the price at a prohibitive level. The present production in the island, moreover, provides an excess of not less that 8000 puncheons per annum beyond the requirements of local consumption and the foreign markets. The Sugar Board is advancing planters £7 per puncheon on this rum, while the planters are themselves paying £4 each for 8000 puncheons to hold rum that cannot be sold at any price at all.

The solution of this serious problem, we are told, is clearly the conversion of these 8000 surplus puncheons of rum into etherized motor spirit for use in the Colony. A co-operative factory to deal with this 800,000 gallons of rum and to distribute it as etherized motor spirit in steel drums would cost about £25,000. The planters should receive 1s. 4d. per gallon of 40 o.p. rum from such a factory if the product as motor spirit were sold at 2s. per gallon. If excise equal to the import duty of 5d. per gallon were charged and the usual trade profits allowed for, the public would obtain this motor spirit at 2s. 9d. per gallon. The effect of this enterprise would be most advantageous to the sale prospects of the better classes of Jamaica rum, while the interests of the taxpayer and the planters are both affected adversely if rum be over-produced and the market glutted as at present. On the other hand, our correspondent elsewhere expresses the opinion that for the success of the scheme much depends on whether the Government will put a sufficient extra duty on imported gasolene.

Owing to the serious slump in profits resulting from the fall in the price of sugar since 1920, Jamaica planters, according to the above-mentioned Report, have shown less activity as regards improved methods of cane cultivation, new varieties, and the treatment of the Mosaic disease. This latter has been eradicated at the Experiment Station by the persistent destruction of infected plants, but elsewhere on some areas the disease has spread to a considerable extent. There is strong reason to believe that maize is one of the chief means of spreading it to sugar canes in Jamaica. And circumstantial evidence is also accumulating that some form of winged insect is the chief agent in spreading the virus of Mosaic disease to healthy plants.

The Japanese Sugar Trade Depressed.

A Department of Overseas Trade report on Japan up to June last reveals a disappointing state of affairs in the Japanese sugar industry in Formosa. "The unsatisfactory state of trade in Formosa (it states) is but a natural outcome of the existing world-wide depression. There is, however, one peculiar contributory factor here which should not be overlooked. The prosperity of the island is too closely bound up with that of the local cane sugar industry for real economic health, and that industry, quite apart from the general difficulties confronting cane sugar manufacturers all over the world, is on an utterly unsound basis. With enormous immediate profits before them during the war and succeeding years, the Formosan sugar companies cheerfully sacrificed the future welfare of the industry. Dividends of 100 per cent. and more were distributed, capital was doubled, mill capacity was increased two or threefold, rotation of crops was neglected and cane planted year after year on the same land. Lastly, the cost of living and consequently that of labour was driven to absurd figures. The companies are now confronted with a collapsed market, excessive milling capacity, impoverished soil and production costs which render competition with other sugars difficult even in the tariff-protected Japan market. Re-construction in this industry must precede a return to the prosperity of the past. Indeed, it is by no means certain whether the sound policy would not be to abandon cane cultivation and revert to rice."

We question though whether such a policy *would* be sound; it would merely mean the loss of valuable sugar milling properties in the island of Formosa on which a very large sum of money has been expended, the elimination of say 400,000 tons of sugar from the world's cane sugar supply, and a corresponding competition on the part of Japan to secure that sugar from other sources, supposing she does not succeed in developing a new cane or beet sugar industry. Re-construction there must be, but with the example of Cuba before her, it is hard to believe that Japan will relinquish without further effort a big industry that she has been at such pains and expense to build up in her principal dependency.

Fifty Years Ago.

From the "Sugar Cane," November, 1872.

In this issue of our predecessor there were only two articles which appear of sufficient importance to recall for the attention of our readers, the other contributions being mainly of ephemeral interest, though doubtless valuable enough at the time of their publication.

The first was a Report made by the Commissioners from Antigua appointed to enquire into the working of the central sugar factory system in the French colonies of Martinique and Guadeloupe, which report shows that a large amount of detailed information had been collected. Mention may be made of some of the particulars given. In the district of Lamentin, Martinique, for example, it is said that the factories were mostly small, and that the cost of cultivating 1 ton of sugar was £10, and of general expenses £4. This sugar brought £22 per ton, and in addition each ton of sugar gave 50 gall. of molasses, which when made into rum, was worth £2, so that a total profit of £10 therefore resulted on each ton of sugar made. Usually the yield of sugar was 7 per cent. of the weight of cane. In both the islands, clarification was effected with lime alone, calcium bi-sulphite (which was in favour elsewhere at that time) not being employed. Animal charcoal, however, was still in use, and in discussing the operation of this part of the plant it was mentioned that a difficulty sometimes experienced was the supply of sufficiently pure water for washing, since "water charged with earthy or saline matter will not suit, as the absorption of these by the charcoal is not rectified by the revivification process. . . ." This revivification process consisted in washing and reburning.

The second article in this issue is one of much historical interest to the chemist, being a detailed illustrated description by the Rev. John H. Jellett, M.A., Professor of Natural Philosophy in the University of Dublin, of his "new optical saccharometer," which had been constructed for him by Spencer & Son to embody his photometric principle of determining the critical point. This instrument is shown inclined at an angle of 45° to the horizontal; and its principal parts were as follows:—Lamp; lenses; Nicol prism; a cell to contain a liquid of opposite rotatory power to sucrose; a tube to contain the solution under examination, capable of being lowered into the cell last mentioned, the extent of its movement being indicated on a scale provided with a vernier; and, lastly, Jellett's analysing prism and a lens. In using this apparatus for the determination of the strength of a saccharine solution, a certain quantity of levo-rotatory turpentine was placed in the cell, the amount depending on the strength of the solution under examination. Then the observation tube was filled with a solution of sugar, the concentration of which was known, this tube being placed in position, and the zero of the vernier made to coincide accurately with the zero of the scale. The milled head controlling the movement of the tube was rotated until the tints on the two parts of the circular image became equal, the scale reading being noted, which procedure was repeated after the tube had been refilled with the solution under examination, the data for the calculation of its concentration thus being obtained. Following his description of the operation of his "saccharometer," Jellett mentioned that it was not desirable to use a very strong solution of the substance under examination, owing to the imperfect compensation existing between fluids of opposite rotatory powers in certain cases, the error thus resulting being "very perceptible indeed."

The New American Tariff.[1]

Schedule of the Sugar Duties.

The following passages as affecting sugar are extracted from the Tariff Law which went into effect on September 22nd, 1922:—

SCHEDULE 5.—SUGAR, MOLASSES, AND MANUFACTURES OF.

PAR. 501.—Sugars, tank bottoms, syrups of cane juice, melada, concentrated melada, concrete and concentrated molasses, testing by the polariscope not above 75 sugar degrees, and all mixtures containing sugar and water, testing by the polariscope above 50 sugar degrees and not above 75 sugar degrees, one 24/100 cents per lb., and for each additional sugar degree shown by the polariscopic test, 46 one-thousandths of one cent. per lb. additional, and fractions of a degree in proportion.

PAR. 502.—Molasses and sugar syrups, not specially provided for, testing not above 48 per cent. total sugars, 25 one-hundredths of one cent. per gallon; testing above 48 per cent. total sugars, 275 one-thousandths of one cent. additional for each per cent. of total sugars and fractions of a per cent. in proportion; molasses testing not above 52 per cent. total sugars not imported to be commercially used for the extraction of sugar, or for human consumption, one-sixth of 1 cent. per gallon; testing above 52 and not above 56 per cent. total sugars not imported to be commercially used for the extraction of sugar, or for human consumption, one-sixth of 1 cent. additional for each per cent. of total sugars and fractions of a per cent. in proportion.

UNITED STATES IMPORT DUTIES ON RAW SUGAR.

Basis Test	On Full Duty Cents per Degree	Differential Duty 20 % off on Cuban Sugar Cents per Degree	Basis Test	On Full Duty Cents per Degree	Differential Duty 20 % off on Cuban Sugar Cents per Degree
100°	2·390	1·9120	87	·792	1·4336
99	2·344	1·8752	86	1·746	1·3968
98	2·298	1·8384	85	1·700	1·3600
97	2·252	1·8016	84	1·654	1·3232
96 (Stan. Basis)	2·206	1·7648	83	1·608	1·2864
95	2·160	1·7280	82	1·562	1·2496
94	2·114	1·6912	81	1·516	1·2128
93	2·068	1·6544	80	1·470	1·1760
92	2·022	1·6176	79	1·424	1·1392
91	1·976	1·5808	78	1·378	1·1024
90	1·930	1·5440	77	1·332	1·0656
89	1·884	1·5072	76	1·286	1·0288
88	1·838	1·4704	75	1·240	0·9920
	Diff. 0·046	Diff. 0·0368		Diff. 0·046	Diff. 0·0368

We regret to record the death from malignant malaria of Mr. L. LEWTON-BRAIN, Director of Agriculture in the Federated Malay States. Mr. LEWTON-BRAIN who was only 43 at the time of his death had been in close touch with the botanical side of the cane sugar industry, first of all in connexion with the Imperial Department of Agriculture in the West Indies from 1902-1905, afterwards in Hawaii from 1905-1909, in which year he was appointed to the position he held at his death. Amongst many contributions to the technical side of botanical research, it may be recorded that in 1904 he was the first to perform the operation of ex-controlled hybridization of the sugar cane, obtaining seedlings of definitely known parentage.

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[1] From WILLETT & GRAY.

Jamaica News.

(From a Correspondent.)

The heavy rains during the last months of the 1921 harvesting season were followed, in most sugar sections, by a partial drought from January to the present; only a few favoured sections having anything near an ideal cane growing season. Even with such handicaps as excessive rain, drought and lack of finances to properly cultivate the cane, a normal crop of 45,000 to 50,000 long tons of sugar has been produced in recognized factories; that is, factories producing grocery crystals or 96° test sugar. Probably 4,000 to 7,000 tons of wet sugar is produced by "one-horse" mills established throughout the mountains and sold in the market and Chinese shops, as this is practically the only sugar consumed by the common labouring population, numbering probably more than 500,000.

The £400,000 sterling loaned by the Government to the sugar planters in 1921 was on a basis of £10 sterling per ton of sugar and £7 sterling per puncheon of rum; a Sugar Board appointed by the Government at the time having the authority to dispose of the products as all money from the sale of sugar or rum was to be used in paying the loan received from the Government. The Board reports all sales of sugar have been made in excess of £10 sterling, the lowest price at which sales were made was £13 f.o.b. and the highest £15 10s. f.o.b. The average price obtained for the rum notwithstanding the serious condition of the rum market has been in excess of £7 per puncheon. The market value of both sugar and rum being so close to the cost of manufacturing these products, the Government has passed another bill authorizing £350,000 to be raised in the same manner and distributed under the same conditions as the loan of 1921. It is expressly provided that the £350,000 is not to be in addition to the £400,000 originally authorized but that it shall be in proportion to the amount repaid of the £400,000; in other words, the money loaned under the 1922 bill will really be money realized from the sales of the present crop, and the liability of the Government will not exceed the £400,000.

The sugar planter who was not obligated to the Government and who was also fortunate enough not to be forced to dispose of his sugar at the beginning of the season sold some sugar above £16 per ton and in all probability made a small profit on every ton of sugar produced; however, there are not many such cases. As there are no supply houses in Jamaica where a planter may get on short notice the materials needed in sugar and rum manufacture, the planters usually buy from one to two years' supply at the time, which system resulted in a big loss in some cases this year. The writer knows of one or two instances in which the puncheons purchased in 1920 or 1921 cost more than the same puncheon filled with rum sold for in 1922. There has been some agitation for co-operative buying of supplies but this has not become effective.

The cane farmer usually receives five per cent. of the average price of 96° test sugar for that month for his cane, that is, if sugar sells for £12 per ton he receives 12 shillings per ton for the cane delivered. Prices ranging from eight to fifteen shillings per ton of cane were paid for the 1922 crop. The freight rates were so high that the cost of harvesting had to be kept as low as possible, so the cane cutter was paid only 6d. to 9d. per ton for plant cane and 9d. to 1s. per ton for ratoon; however, the work was carried on very reluctantly by the labourers and very few of them cut more than four and a half days per week. The factory labourer was paid 1s. 9d. to 3s. 6d. per day and he took very little more interest in his work than did the cane cutter. The cost of clothing and food had not been reduced in proportion to the wages, and the common labourer is not inclined to exert himself when he feels that he is not being properly paid and can live with very little work on cheap native products.

Just at the time sugar had reached such a low price, bananas were selling for 3s. 6d. to 6s. per bunch, guaranteeing a very good profit per acre; however, Jamaica's banana market is usually kept very active by such competitive companies as the United Fruit, Atlantic Fruit, and the Jamaica Fruit and Shipping Co. The fact that bananas are paid for upon being delivered to the railway, require less labour expenditure, and are better adapted to the average soil which was previously in bananas but put into cane during high sugar prices, is causing hundreds of acres to be put back into bananas. The value of this statement may be evidenced by the fact that in 1919-1920 a central sugar factory was erected with the expectation of harvesting about 150,000 tons of cane the first crop and between 150,000 and 200,000 tons of cane annually thereafter; however, during the three years' operation this factory has never ground 100,000 tons of cane during one crop nor has its cane supply materially increased. Only one of the new sugar factories established ("Sevens" owned by Grinan) has reached its estimated sugar capacity for the crop and a number of those erected in the mountains will never pay their owners like bananas previously did and it will doubtless be years before any interest will be received on the investment.

The Central Factory to be established in the parish of St. Thomas by the Jamaica Government has been admitted to be a failure after the Government has paid out about £5000 sterling, and for cane planted on more than 400 acres. It will be remembered that a consulting engineer was brought out by the Government from Scotland to select the site of the factory, and this enterprise along with others such as the Lettitz Sisal Factory, the Milk Factory and the proposed cooperative Motor Spirit Factory, have instilled in the minds of the people very little confidence in Government enterprises.

The difference between the General Tariff and the British Preferential on sugar in England amounts to approximately £3 10s. per ton of sugar; nevertheless sugar manufacture under Jamaica conditions at present prices is rather hazardous since the extremely high duty on rum has gone into effect. Jamaica produces excellent grocery crystals for direct consumption which have no market value in Canada due to the operation of the Dutch Colour Standard and she feels that the refiners there should not be so favoured.

The duty on a proof gallon of rum in Great Britain was raised from 14s. 9d. per gallon to 72s. 6d. per gallon, making the British Government receive approximately £500 sterling per puncheon of rum shipped (testing above 78 per cent. by volume) and the Jamaica Government collects £60 revenue per puncheon while the producer receives a gross return of £8 to £10 per puncheon. The producer receives nothing on the phns. which may have cost him from £2 to £5 when new. Of the 16,000 or more phns. of rum annually produced in Jamaica about 4,000 are sold locally and consumed in the island, leaving 12,000 phns. for export, if possible, at a prohibitive duty. Naturally the Jamaica sugar manufacturer has become nervous over the situation since the price is not only very little above the present cost of manufacture but the storage facilities at present are not adequate for any prolonged dullness in export shipment, as all rum is stored in phns. of approximately 112 gallons each. It must be remembered that the Jamaica factories are very small, especially equipped for the manufacture of rum, and as rum has been one of the principal factors in keeping the estate in existence, anything that stagnates the rum trade is extremely detrimental to the existence of the factory. Protests were received by Mr. Edward Wood, Under-Secretary of State for the Colonies, from the West Indian rum producers and Scotch distillerymen; Jamaica sending to England her ablest and most influential man in the person of Mr. A. W. Farquharson to plead her case. Jamaica's plea for a greater preference on sugar and a reduction of the duty on rum to 50s. per proof gallon did not meet with the approval of the British Government but they agreed to continue the existing preference on sugar for 10 years. The reduction of the duty on rum was turned down on the plea that the duty was about the same on rum to England as on whiskey, therefore they could not give preference over their own people.

At the instigation of the Director of Agriculture a meeting was called by the Government to propose the establishment of a Motor Spirit factory capable of utilizing 8,000 phns. of rum annually in the production of motor spirit; the planters were asked to pledge the delivery of a proportionate amount of their rum crop for that purpose; however, as usual, nothing materialized. The Gray's Inn factory has ordered an etherizing plant as a complement to their continuous still; their desire being to produce only pure alcohol and supply any demand for motor spirit. The alcohol is stored in iron tanks and will be put on the market in iron drums similar to those in use for the distribution of gasoline; however, the Government has given no guarantee to put enough duty on gasoline to make the production of motor spirit profitable. The use of motor spirit in Jamaica should develop rapidly with the great amount of freight that is being transported by motor trucks (due principally to the high freight rates charged by the Government railway and to the topography of the island) in addition to that which could be used in automobiles. Concentration on the production and establishment of a market for motor spirits produced from a portion of the 12,000 phns. of rum which Jamaica now finds necessary to export annually would help materially to tide over the depression caused by the high duty placed on rum.

It is believed by some sugar men that the American financiers and refiners are out to crush the British sugar industry because the Webb Act of the American Congress will permit the refining of surplus Cuban raws in bond for the purpose of export to the European markets.

The poor financial condition of the Jamaica Government and the people, high taxation imposed by local and Mother Governments, and a minority of elected members in the Legislature may be credited partially for the unrest prevailing in Jamaica. In 1920 a super tax law was passed based on a progressively increasing sliding scale which penalizes the holding of property beyond the value of £15,000 by any one Company or individual; such a law can have no effect other than to handicap efficiency and economy in production. The duty on some of Jamaica's principal products such as cocoa, coffee and tobacco is some times greater than its market value f.o.b. and better offers are received from other countries than England. The Jamaica Government railway has also come in for its share of criticism and a body of business men including elected members of the Legislature made an appeal to Mr. Wood, Under-Secretary of State for the Colonies, claiming that the Government was spending the taxpayers' money without sufficient regard to the financial ability of the colony. The 197 miles of Government railway is responsible for over £600,000 of the £4,000,000 sterling public debt and it is averred that it has an annual deficit of more than £4,500 on ordinary working expenses. A desire has been expressed by the elected members for a change in the Constitution, as they are in the minority and the people have no representative on the Privy Council in which legislation financial and otherwise is initiated; also, it is claimed that all appointive Public Offices are held usually by Englishmen who are not familiar with the conditions of the country. The Jamaicans, however, are loyal to their mother country but feel now that they have advanced to the point where they should have more voice in the affairs of their colony.

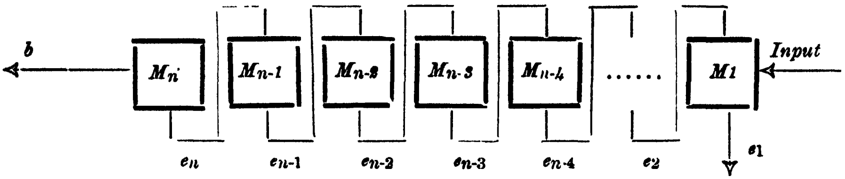
The Formula for Compound Imbibition.

By LEWIS WACHENBERG.

In a recent number of this *Journal*,[1] Mr. P. H. PARR has given a complete solution of the problem of compound imbibition; his solution which entails the use of determinants is complete to the extent that variation in the value of r is included. I had previously supplied Mr. DEERR with a solution of this problem, treating r as constant, in which as has already been pointed out an error in substitution arose giving an incorrect general formula.

Another treatment of the problem is given below, in which r is taken as contant and the correct general formula, for r constant, is obtained.

Consider a train of mills arranged thus:—



M_n = nth mill; M_{n-1} = mill next to it, and so on; M_1 = first mill.
b = Material discarded in the bagasse.
e_n = ,, extracted in M_n and returned to M_{n-1}, and so on.
e_{n-1} = ,, ,, M_{n-1} ,, M_{n-2},
e_1 = ,, ,, M_1 and introduced into the manufacturing process.

$$\text{Now, } \frac{e_n}{e_n + b} = r\text{; whence } e_n = \frac{br}{1 - r} \qquad (1)$$

$$\frac{e_{n-1}}{e_{n-1} + e_n + b} = r\text{; whence } e_{n-1} = \frac{br^2 + br\,(1 - r)}{(1 - r)^2} \qquad (2)$$

$$\frac{e_{n-2}}{e_{n-2} + e_{n-1} + b} = r\text{; whence } e_{n-2} = \frac{br^3 + br^2\,(1 - r) + br\,(1 - r)^2}{(1 - r)^3} \qquad (3)$$

$$\frac{e_{n-3}}{e_{n-3} + e_{n-2} + b} = r\text{; whence } e_{n-3} = \frac{br^4 + br^3\,(1 - r) + br^2\,(1 - r)^2 + br\,(1 - r)^3}{(1 - r)^4} \qquad (4)$$

$$\frac{e_{n-4}}{e_{n-4} + e_{n-3} + b} = r\text{; whence}$$

$$e_{n-4} = \frac{br^5 + br^4\,(1 - r) + br^3\,(1 - r)^2 + br^2\,(1 - r)^3 + br\,(1 - r)^4}{(1 - r)^5} \qquad (5)$$

Hence, $e_1 = e_{n-(n-1)} =$

$$\frac{br^n + br^{n-1}\,(1 - r) + br^{n-2}\,(1 - r)^2 + br^{n-3}\,(1 - r)^3 + br^{n-4}\,(1 - r)^4 + \;.\;.\; + br^{n-(n-1)}\;(1 - r)^{n-1}}{(1 - r)^n}$$

Whence, $e_1\,(1 - r)^n =$

$$br^n + br^{n-1}\,(1 - r) + br^{n-2}\,(1 - r)^2 + br^{n-3}\,(1 - r)^3 + \;.\;.\;.\; + br^{n-(n-1)}\;(1 - r)^{n-1} \qquad (6)$$

Multiplying both sides of this equation by $r^{-1}\,(1 - r)$,

$$e_1\,r^{-1}\,(1 - r)^{n+1} = br^{n-1}\,(1 - r) + br^{n-2}\,(1 - r)^2 + \;.\;.\; + br^{n-(n-1)}\;(1 - r)^{n-1} + br^{n-(n-1)-1}\;(1 - r)^n \qquad (7)$$

Subtracting equation (7) from (6).

$$e_1\,(1 - r)^n - e_1\,r^{-1}\,(1 - r)^{n+1} = br^n - br^{n-(n-1)-1}\,(1 - r)^n = br^n - b\,(1 - r)^n$$

$$\text{Whence, } e_1 = \frac{br^n - b\,(1 - r)^n}{(1 - r)^n - r^{-1}\,(1 - r)^{n+1}}$$

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[1] *I.S.J.*, 1922, 95.

The Formula for Compound Imbibition.

The total material introduced =

$$e_1 + b = \frac{br^n - b(1-r)^n + b(1-r)^n - br^{-1}(1-r)^{n+1}}{(1-r)^n - r^{-1}(1-r)^{n+1}} = \frac{br^n - br^{-1}(1-r)^{n+1}}{(1-r)^n - r^{-1}(1-r)^{n+1}}$$

Therefore, extraction per unit = E =

$$\frac{e_1}{e_1 + b} = \frac{br^n - b(1-r)^n}{br^n - br^{-1}(1-r)^{n+1}} = \frac{r\{r^n - (1-r)^n\}}{r^{n+1} - (1-r)^{n+1}}$$

It should be noted that when $r = 0{\cdot}5$, $\frac{r\{r^n - (1-r)^n\}}{r^{n+1} - (1-r)^{n+1}}$ will reduce its numerator and denominator to 0 if direct substitution for r is made, because of the fact that the common factor $(2r - 1)$ is 0 when $r = 0{\cdot}5$. It is, therefore, necessary to eliminate the common factor first by substituting only for n, and then the substitution for r may be made. For any other value of r such procedure may be dispensed with.

Explosion of Sugar Dust, its Causes, and Prevention.[1]

By P. BEYERSDORFER.

During the course of the past three decades there have occurred in the German refineries 50 slight, 9 moderate and 8 severe dust explosions, as the result of which many lives and much property have been lost. An idea of the frightful effect of a sugar dust explosion may be obtained by studying the details of the disaster which occurred in May, 1917, in the pre-crushing room of the Frankenthal refinery, when the walls which were 800 mm. (2 ft. 7½ in.) thick were blown out, six men were killed, and several were injured. A striking observation has been made in regard to these catastrophes, namely, that with one exception (and in that case data are lacking) they occurred immediately after starting work. This is a fact that will be commented upon later.

PREVIOUS WORK ON THE SUBJECT.

As S. F. PECKHAM[2] showed in 1907, all kinds of combustible dust are dangerous. R. V. WHEELER[3] in 1912 examined about 60 kinds of dust, established their inflammability and explosive power at certain high temperatures, and classified the substances according to what he considered was their degree of danger; sugar, which was found to have an ignition temperature of 540°C., being placed in the first class. TAFFANEL AND DURR[4] in 1911 established 460°C. as the minimum temperature for the ignition and explosion of sugar dust. F. WEINMANN[5] in 1917 stated 475 C. to be the lowest temperature at which explosions could occur; and 72 grms. per cub. m. to be the lowest concentration of the mixture of dust and air capable of being detonated; while regarding the highest concentration, it seemed to this investigator that none existed; since, even at the density of 4.5 kg. per cub. m., an explosion could occur under his conditions of working. ENGLER[6] in 1895 established the effect of the addition of explosive gases to the explosive dust; while H. H. BROWN[7] in 1917 measured the pressures that result from explosions.[8]

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[1] *Vereinszeitschrift*, 1922, 475-533. We here give an abstract, not a translation, of the original article, which runs to 59 pages.

[2] *J. Soc. Chem Ind.*, **26**, 244. [3] *J. Chem. Soc.* **103**, 1715. [4] *Comptes rendus*, **152**, 718.

[5] *Zeitsch. fur Berg-, Hutt, u. Sal.-Wesen*, 1920, **68**, 100.

[6] *Chemische Industrie*, 1885, 171, 385. [7] *J. Ind. Eng. Chem.*, 1917, 269. [8] Other references not included in the author's list are: L. PELLETT, *I.S.J.*, 1913, 290; Dr. WHEELER, *I.S.J.*, 1915, 301 (Home Office Reports, Cd. 6662).

As to the precautions that should be observed for the prevention of sugar dust explosions, these appear at present to be as follows: That at no place where the dust is formed must the temperature reach 425°C., or the concentration 72 grms per cub. m. That therefore open or closed lights must be abolished; the occurrence of short circuits must be guarded against by the use of strongly armoured cables; the danger of sparking in the electric motors must be obviated by enclosing the machines in dust-proof casings; the over-heating of bearings must be constantly watched, and lubrication carried out with care; and attention must be paid to the prevention of the presence of foreign bodies (especially lumps of iron) in the crushing machines by passing the sugar between strong magnets and compelling the workmen to change into suitable footwear. Then for the collection and removal of the dust, at the present time, chambers, dry-air filters, "cyclones" and systems of precipitating the dust with water, are all used. The prevailing opinion regarding these methods of dealing with the dust appears to be that the value of so-called dust chambers is doubtful; that dry-air filters are useful and still hold the field; but that dust precipitation by means of water in combination with a "cyclone" is now gaining favour.[1]

THERMAL INVESTIGATIONS.

In the experiments carried out by the author, a glass explosion flask having a capacity of about 600 c.c. was used, it being provided with three tubes, the first for blowing in the sugar dust, the second for introducing the gases used, and the third for an exhaust. This explosion flask was enclosed in a copper vessel, which was lagged to prevent heat radiation, and was raised to the desired temperature by a suitable burner; while for the measurement of the heat (an ordinary mercury thread thermometer being too slow in action) a thermo-element apparatus, calibrated by means of Lindeck's compensation method, was employed.

The following results were established: The temperature of ignition of sugar dust is 410°C. in air, and 371°C., in oxygen; this temperature of ignition being dependent on: (*a*) the oxygen content of the gases; (*b*) the heat conductivity of any relatively inert gases which may accompany the oxygen; and (c) the carbon dioxide content, which gas was found to have a depressing effect considerably greater than that of nitrogen. The lowest concentration at which an explosion may occur was calculated to be 17·5 grms. per cub. m., and the highest was experimentally ascertained to be 13·5 kg. per cub. m. Thermal sugar dust explosions occur in two phases, viz., first the gasifying of the sugar dust; and second, the oxidation of the "sugar gases."

ELECTRICAL INVESTIGATIONS.

Few would believe that the cause of sugar dust explosions may be of an electrical nature, and E. O. VON LIPPMANN[2] once wrote at the foot of an abstract dealing with a catastrophe of this kind that "it is extremely improbable that electrical charges are concerned." However, W. A. D. RUDGE,[3] carried out an important research on the generation of electricity by 180 kinds of dust clouds, and came to the following conclusions:

"Nearly all kinds of finely divided material when blown into a cloud of dust by a current of air give rise to electrical charges upon the dust and upon the air. The nature of the charge resident upon the dust particles depends upon the chemical characteristics of the material. In general, the charge obtained upon the dust is opposite to that associated with the ion of the same substance when in solution, i.e., strongly basic bodies give negatively charged dusts, and strongly acidic bodies give positively charged dusts. In the case of salts the charge apparently depends on the relative strengths of the acidic and basic ions. Similarly constituted bodies give similar charges."

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[1] A very complete description of crushing apparatus and dust separating devices is given in Naske's "Zerkleinerungsvorrichtungen und Mahlanlagen," third edition. Another book well worth consulting, is "Entstaubungs—und Entnebelungsanlagen." By W. DÜCHTUNG. (A. Seydl, Berlin.)—ED. *I.S.J.*

[2] *Chem. Zeit.*, **42**, 126. [3] *Philosophical Magazine* (Edinburgh), Series 6, **25**, 481.

Before Rudge took up the matter, A. Coehn and M. Raydt[1] had studied the generation of electricity by dielectrics. That particles chipped or filed off sugar crystals are electric had been long before established by Volta[2] in experiments with his electroscope. Further, it has been generally known in the cases of ether, benzine and benzene[3] that readily inflammable dielectrics may ignite owing to the static electricity which may be produced by Guericke's phenomenon.

Up to the present time, however, no one has carried out electro-static experiments with sugar dust, though our present knowledge of the subject seems to suggest that the cause of dust cloud explosions may very well be electrical as well as thermal. A further suggestion leading towards this line of thought is the observation (already referred to) that these disasters occur immediately after starting the crushing operations.

In the writer's first electrical experiments, he followed Dolezalek-Holde's procedure.[4] An electrode, connected with a straw electrometer, was suspended in a conical flask; and upon this electrode a blast of sugar dust from a reservoir was caused to impinge. A strong deflection of the needle (almost to 90°) thus resulted, the charging of the sugar dust by whirling it through the air in the reservoir thus being demonstrated. In another test it was proved that the sugar becomes positively charged in this way, and the air itself negatively. This charging of sugar dust with electricity is very considerable, one experiment showing that if 10 mgrms. of sugar dust were blown from a distance of 5 cm. into a copper cylinder connected with an aluminium-leaf electrometer the potential thus generated amounted to over 200 volts. On turning a piece of sugar in the lathe with a piece of steel, and catching the particles thrown off on the top of an electrometer, a charge of 128 volts was observed.

It was of interest next to ascertain whether it was possible to produce an electrification with quiescent sugar dust by an electrical charge, since it should be immaterial whether the whirling sugar dust incites the electrification, or whether the silent discharge is effected in some other way. A little sugar was brought into the alternating field of a Siemen's ozonizer (using a slow current of oxygen), the high tension current being shut off after some minutes An explosion accompanied by a yellow flame was observed, and the sugar was found to be decomposed. When air instead of oxygen was used, the final result was the same, though no explosion was heard, and no flame was seen. It is added by the author that this experiment was not often reproducible.

It is known that silent discharges ozonize air, nitrogen pentoxide being also formed; and one can at once conclude what the result will be when reactionable gases like O_3 and $N_2 O_5$ are brought into contact with "almost molecular sugar" under the influence of the high tension electric current. An explosion can only occur.

Indeed there appears to be a fairly close analogy between a thunderstorm and a sugar dust explosion, the stages in the latter case being: the whirling of the dust; the resulting electrification of the cloud; the silent discharge with sudden arrival at the iso-electric point; production of O_3 and N_2O_4; the reaction of these gases with the extremely fine sugar; the formation of the "sugar gases"; and lastly, the explosion of these so-called sugar gases. Then one may conceive the dust as an "æro-sol," i.e., a colloidal solution of sugar in air, in which condition it exerts an adsorbing power towards gases, in this case, oxygen. This adsorption of oxygen by the sugar dust in its very fine state may explain to some extent the great violence of such explosions.

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[1] Annal. Phys., 30, 804.

[2] "Opere," 1. 2, 259.

[3] See Holde's "Untersuchungen d. Kohlenwasserstofföle und Fette," 5th edition, page 173

[4] *Ibid.*

Some experiments were carried out for the purpose of ascertaining whether the phenomenon of triboluminescence, which arises when sugar is crushed, can in any way be regarded as the case of sugar dust explosions. It was concluded that it could not be considered as contributing in any way.

Further, since there seems to be an analogy between thunderstorms and sugar dust explosions, it was of interest to examine whether at the time of the occurrence of dust explosions an unusual state of terrestrial magnetism existed. A careful examination of the meteorological records of the De Bilt Observatory (Holland) proved this line of enquiry to be also negative.

DISCUSSION OF THE RESULTS OBTAINED.

Regarding the cause of sugar dust explosions in practice, one may conclude that these occur in the following order of events. In one or other of the disintegrating machines, a whirl or vortex of dust is set up; its concentration reaches the danger limit; ignition occurs, either from a thermal or an electrical cause; and the result is a local explosion. The sudden air pressure resulting from this explosion causes dust in another part of the disintegrating machine to whirl, and this cloud is ignited by the flash of the first ignition; and so on, whirling, ignition and explosion continuing until the dust chamber is reached.

It would, therefore, appear to be immaterial in which state the dust is present in any part of the apparatus, whether deposited on the floor of the dust chamber, or whether floating as an "ærosol" around the crushers. The conclusion is that sugar dust, whether quiescent or floating, should not be allowed to accumulate in any place, especially in the dust chambers, which in fact may be regarded as the principal danger spot of the plant.

Dust accumulation may be mitigated by the use of crushing apparatus which as closely as possible meets the demands of an ideal disintegration, that is comminution to the desired stage without the formation of undesirable very fine dust. As a means of approaching this ideal disintegration, crushing should proceed in three stages: (1) preliminary reduction by means of pre-crushers (as jaw crushers); (2) coarse grinding by means of rough grinders (as roller mills); and (3) fine comminution by means of mills (as pulverizers). In the use of these crushing apparatus, attention must be paid to the most thorough separation of the dust by the insertion of pipes for its withdrawal at the most suitable places. In regard to the pulverizers, these should not be allowed to run at too high a rate of revolution, 3000 per min. being much too rapid.

Regarding the dust separating plant, only those types come into consideration in which no accumulation of dust can occur. As such, only those may be included which belong to systems in which the precipitation is effected with water, operating preferably in combination with a "cyclone," the dust passing first through the water tanks. As a further precaution, the dust-separating plant should be de-centralized.

Of importance in connexion with explosions is the type of conveying and elevating apparatus which is used. It is desirable previously to separate the fine dust by sieving, and to convey the coarse and fine material away from the mill separately. Removal of the coarse material may be suitably effected by means of conveyor belts and bucket elevators; while that of the fine dust is best accomplished by means of screw elevators in combination with bucket elevators. Pneumatic conveying is out of the question, for the reason which now must be apparent, namely, that in this system the sugar would be rushed along with relatively high rapidity, and in consequence would become highly charged, in addition to which there would be the danger of the concentration of the dust within the limit at which an explosion might occur.

At this point it is possible to offer a reason in explanation of the observation that explosions appear always to occur immediately after starting up the plant. This may be because when starting up there is considerable resistance to be overcome until the mill is in operation. It is then that the most violent whirling of the dust takes place, besides which the charged particles are at that time closest to one another. Thus, the dust becomes electrified, and when the extreme limit is reached the potential is discharged with a spark. Before this point is reached, a discharge accompanied only by glowing has been taking place in the field between the sugar cloud and the metal, ozone and nitrogen pentoxide having been formed, which gases have reacted with the almost molecular sugar. Then comes the spark, and the explosion is completed.

In all places, therefore, in the plant where dust is in movement. precautions must be taken to remove the static charges by connexion with earth. Pre-crushers and rough-grinders should be connected to earth from all accessible metal parts, and the removal of the static electricity generated by the driving belts should be carried away by connecting the pulleys to earth and by keeping the belts constantly moist with a mixture of glycerin and water (1 : 1). Steel should be used in place of balata for the belt conveyors, since from the metal the electricity may easily be removed.

A Certain Means of Prevention.

For flame formation three things are necessary, viz., fuel (here sugar); oxygen; and energy (either heat or electricity); and if one of these factors is absent, or if it is reduced sufficiently in amount, then combustion cannot take place. It should be possible in practice by the addition of a relatively inert gas, either carbon dioxide or nitrogen, to reduce the oxygen so that the explosion of sugar dust is preventable. One should select the gas having the maximum extinguishing power (that is, having the greatest heat conductivity), in this case carbon dioxide, and the amount should be such as will reduce the oxygen content of the air to less than 9 per cent.

Already at the present time crushing apparatus is entirely enclosed in order to prevent the escape of dust into the rooms; and there should exist no practical difficulty in displacing the oxygen of the air in these machines by the addition to it of sufficient carbon dioxide to reduce the oxygen content of the mixture to about 9 per cent. Sufficiently pure CO_2 may be obtained from some neighbouring kiln, and the gaseous mixture may perhaps be utilized repeatedly, if fortified with carbon dioxide from time to time, as required. Washed and filtered flue gases would perhaps be cheaper, but they should not contain more than 10 per cent. of oxygen. This addition of an inert gas to the atmosphere around the machines should provide an absolutely certain protection against dust explosions, and technically it would be comparatively easy to put it into operation.

Rats, and their Suppression on the Sugar Plantation.

By C. L. CLAREMONT, B.Sc., F.I.C.,
late Research Chemist on Rat Destruction, Ministry of Agriculture.

(*Continued from page 527.*)

PART II.

When dealing with an actual infestation, it is as well to ascertain which species has to be dealt with, for the means to be taken, as will be shown in the sequel, must be modified to suit the habits of the particular rat. In general it is more difficult to induce *Mus rattus* to take baits than it is with the commoner rat. Thus in India experiments have shown that so particular are they in their diet that if baits be made with a strange meal the rats take but little, whereas if the staple meal of the native inhabitants be used they will consume it readily.

In the previous paper the two commoner rats and their habits were briefly described. Regarding the mouse, it may be added that though often extremely destructive, it is well known, and hardly needs detailed description. In general it is very similar to the "black rat" on a small scale.

SPECIES OF RATS.

Mus rattus, of which a general type description was given, actually occurs in three well marked varieties or sub-species, which, while often found living together or even in one litter, have a certain geographical significance and generally breed true to type. These are (1) *Mus rattus rattus* to which the description given applies; (2) *Mus rattus alexandrinus*, characteristic of Northern Africa and Asia Minor, which is usually less black and with a dingy belly; and (3) *Mus rattus frugivorus*, the roof rat, which is distinctly reddish in hue and is a more or less wild species found generally in Mediterranean countries.

The tendency to a colour change in rats is not confined to *Mus rattus*, which acquired its more sombre hue on becoming acclimatized to the cooler countries of Northern Europe, for *Mus decumanus* has undergone a somewhat similar change in Ireland evolving a blackish race, sometimes distinguished as *Mus hibernicus*.

In India and Burmah, although *Mus rattus* is the commonest, there are several other species, of which two *Mus concoler* or little Burmese rat and *Nesocia bengalensis* or Indian mole rat are deserving of mention, for though perhaps of no great economic importance, they are largely concerned in the spread of plague.

Normally the species infesting sugar plantations are either or both the common world-wide rats, though probably in the East Indian plantations there may be local wild species in addition.

HABITS OF RATS.

It will be as well to amplify somewhat the description of the habits of these rats, for several points which are frequently overlooked are of some significance when dealing with their environment and the actual problems of repression.

We stated that *Mus decumanus* was mainly a burrower; that water is essential for its survival; that it is of omnivorous habits; and that it is by no means particular in its diet. These facts govern its mode of life; and though it is extremely adaptable generally it inhabits an environment which conforms to these needs. This species can and does establish itself in the following situations: in fields, hedge rows, and along water courses (the latter frequently forming a ready means of migration for they are good swimmers), in sewers, sewage farms and manure heaps where it is quite ready to consume ordure and other refuse, and finally in buildings of all kinds. In this latter case, although it is a fairly agile beast, it will usually confine itself to the lower floors burrowing into the brickwork and foundations wherever it can find a weak spot. This rat will often live outside a house, and yet work a way in and use this regularly as a means of reaching a food supply; on the other hand, when established inside it will work itself a path outwards to reach a suitable drinking supply. It invariably establishes well-defined runs, which with a little practice can be readily observed.

Mus rattus, on the other hand, though in warm climates it will live out of doors quite comfortably, generally prefers the shelter and warmth of human habitations and buildings. It never inhabits sewers and will not subsist on ordure; and, though in Europe it has accustomed itself to an omnivorous diet, it is much more particular in its feeding. Owing to its non-burrowing habit, and superior climbing ability, it is frequently found in the top floors of buildings, especially in the roof; and through not requiring much water is not under the necessity of regularly leaving its haunts in search of drink. For similar reasons it is still the chief ship rat.

It is interesting to note that the earliest rat introduced into Great Britain was *Mus rattus* at about the time of the Crusades. *Mus decumanus* only came on the scene about 1700 (hence it is sometimes known as the Hanoverian rat), and in the space of 100 years or less had almost completely exterminated the original invader, which only retained its hold in a few isolated colonies chiefly in the neighbourhood of ports. Of recent years there seems little doubt that this species has tended to increase and re-establish itself, for it is now comparatively common in many parts of London and other large ports.

BREEDING POWER.

Rats and mice are extremely prolific breeders and some extraordinary estimates of the possible descendants of a single pair of rats have been made.

Rats can breed more or less all the year round, though in Europe at any rate pregnant females are commonest between January and June. The period of gestation is 21 days, and young females are sexually mature when three months old, long before they are fully grown which is in about 18 months. The number of litters per doe per annum, and the number of young per litter naturally vary with conditions, food supply and temperature being the most important. *Mus rattus* is most fecund in warm climates, whereas *Mus decumanus* breeds faster in temperate climates. In Bombay it was foumd that *Mus rattus* averaged five young per litter with a maximum of nine; *Mus decumanus* having eight with a maximum of 14. In Great Britain, especially in urban surroundings, larger litters are quite common, as many as 20 being recorded.

With such potential breeding power it is not surprising that rats have spread enormously, and that rat repression presents a really serious problem.

A conservative estimate by LANTZ states that the progeny of one pair of rats at the ninth generation would amount to over 20,000,000 individuals; ZUSCHLAG, the Danish authority, gives 880 rats as the progeny of one pair, assuming six litters a year and no deaths; HINTON,[1] assuming 10,000,000 pairs to be the rat population on Jan. 1st, 1918, and making liberal allowances for deaths and other wastage estimates that on Dec. 31st, 1918, these would have increased to over 40,000,000.

THEIR RÔLE IN PLAGUE AND DISEASE.

Apart from the enormous loss and damage done by rats to food supplies and the destruction caused by their burrowing and gnawing, there is another serious aspect of the rat menace. That is their relation to the spread of disease.

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[1] "Rats and Mice as Enemies of Mankind."

In this connexion the intimate relationship between the rat and the incidence of plague is well established. Plague is an acute infectious disease which is more or less endemic in many parts of Asia, and has at times spread in the form of an epidemic over wide areas, the Black Death of the Middle Ages and the Plague of London in 1665 being well-known instances.

The disease is due to a specific organism, *Bacillus pestis*, and infection is caused in three ways: (1) by the bites of insects, or accidental inoculations of abrasions of the skin, this causing the commonest type known as bubonic plague; (2) by the respiratory tract, giving rise to the less common type pneumonic plague; and (3) by the gastro-intestinal tract which produces septicæmic cases. Human epidemics of plague can usually be traced to a preliminary epidemic among the rat population, the active agent for transferring the infection being the rat flea.

It has been found that certain fleas are characteristic of various hosts ; if their host dies or is ill they prefer another of the same species, but if this is not available they will go to the nearest warm-blooded host. When plague breaks out among rats (and it must be noted that plague is primarily a rat's disease), the infected rats will usually migrate *en masse* leaving their dead behind. The fleas then seek fresh hosts and find them in the human beings at hand. Now in the East the commonest rat is *Mus rattus*, which lives in close association with human beings. Hence an outbreak of rats' plague is rapidly followed by an epidemic among the native population, which spreads to fresh centres as the unaffected rats migrate and in turn become diseased.

In the case of *Mus decumanus*, if rat plague breaks out the chance of it leading to human epidemics is much lessened, for, as stated, this rat does not associate so closely with humans. It is no doubt largely due to the displacement of *Mus rattus* by *Mus decumanus* that plague has ceased to be endemic in Europe.

As Cause of Infection of Native Labour.

This aspect of the rat problem cannot be disregarded by the sugar planter in those countries where plague is endemic, or is likely to be readily introduced by rats from ships trading to and from areas of endemic plague, for native labour is specially prone to infection. The usual mortality in India among natives during an epidemic is in the neighbourhood of 70 per cent.

Rats are also active agents in the dissemination of trichinosis, a disease due to a parasitic worm which affects humans, pigs and rats, the worm after ingestion into the intestines spreading into the muscles. In this case *Mus decumanus* is the culprit, for its feeding habits are uncleanly, the cycle of infection being thus:—rats eat diseased meat (e.g., " measly pork "); the dead rat or its infected dejecta are eaten by the pig ; and the diseased pork eventually reaches the human consumer.

Several other diseases of less importance are spread by rats, and it has been suggested that it is the active agent in spreading foot-and-mouth disease. If this were proved, the fact would no doubt do a great deal to stimulate the farming community to wage a more effective campaign against the pest than they do at present.

Rats and mice are also subject to diseases caused by intestinal germs, which though not normally communicated to man were introduced some years ago as the basis of the so called " Virus " preparations for rat destruction. These preparations have quite recently come under renewed suspicion as the cause of human disease.

The next and concluding article will deal with the various methods of rat repression, including poisoning both by " Virus " and chemical agents, and also give some account of the recent research work on this subject with special reference to that carried out at the Ministry of Agriculture and the preparations which are now available for this purpose[1].

(To be concluded.)

A Study of the "Factor of Safety" of Sugars, with Special Reference to Methods required for the Manufacture of Sugar conforming thereto.

By WM. L. OWEN.
Research Bacteriologist, Louisiana Sugar Experiment Station.

The Colonial Sugar Refining Co., of Australia, is credited with having first elaborated the so-called "factor of safety" for sugar, which may be stated as follows. When the non-sucrose solids of a raw sugar are more than three times its moisture, the sugar will not deteriorate, or expressed as a formula:— $\frac{\text{Water}}{100 - P} = 0{\cdot}333$. The true sucrose or Clerget value is now generally used instead of the sugar polarization value indicated in the formula. Many investigators have made a study of the validity of this "factor of safety" and have reached the conclusion that it is a reliable criterion of the keeping quality of a raw sugar. It cannot be applied to a raw washed sugar, or to a white sugar, and is also unreliable when applied to a sugar that has already undergone appreciable deterioration. Browne[1] who has made a very comprehensive study of the question, concludes that the value of the factor depends largely upon the nature of the micro-organisms present in the sugars, and that the factor would have to be modified for sugars of varying infections. The Kopeloffs[2] studied the factor almost exclusively from the standpoint of its value in interpreting the keeping quality of sugars containing varying numbers of moulds, and also conclude that the value of the factor varied with the degree of infection. Whether the unreliability of the factor of safety on a heavily infected sugar is due to the infection, or whether the heavy infection is usually indicative of some deterioration having already taken place, is still a disputed question. Some time ago the writer[3] pointed out that the probable reason why sugars which have begun to deteriorate do not stop when they reach 0·333, but continue to 0·250 or lower, is that validity of the factor depends upon the fact that it connotes a molasses film of a certain density. The ratio of 3 parts of non-sucrose solids to one of moisture, represents a product of such a purity that it has to be concentrated to a higher density before the sucrose will begin to crystallize. But in undergoing deterioration, the "factor of safety" assumes a purely fictitious value because the non-sucrose solids increase while the density remains practically constant. On the other hand it has been observed by Browne[4], Deerr[5] and others that sugar deterioration rarely proceeds to the point of complete exhaustion of the sucrose in the film of molasses on sugars that are stored in sealed containers. L. LEWTON BRAIN and NOËL DEERR would explain this as resulting from the toxic action of the products of the micro-organisms. The writer, however, is inclined to the opinion that it is due to the increase in the osmotic pressure of the film due to the accumulation of reducing sugars, and to the inhibitory action of non-sucrose solids upon invertase action. Although much attention has been given to testing the value of the "factor of safety" as a criterion of the keeping quality of raw sugars, comparatively little has been published on the manufacturing methods required for the production of sugars that conform to it. BROWNE[1] very clearly explains the basis for the validity of the factor as follows:—

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[1] They are now on the market as the "Klearwell" preparations, the Agents for which for the sugar industry are The Sugar Manufacturers' Supply Co., Ltd., 2, St. Dunstan's Hill, London, E.C.3 (see advert), who will be pleased to offer technical advice relating to the rat problem on plantations.

[1] *J. Ind. Eng. Chem.*, 1918, 181; *I.S.J.*, 1918, 226, 265, 319.

[2] *La. Bulletin*, No. 170; *I.S.J.*, 1920, 282.

[3] *La. Bulletin*, No. 162; *I.S.J.*, 1919, 280.

[4] *J. Ind. Eng. Chem.*, 1918, 10, No. 3; *I.S.J.*, 1918, 226, 265, 319.

[5] *H.S.P.A. Bulletin*, No. 9, 1909, 178.

> "If we suppose no dissolved sucrose to be present the limiting ratio of $\frac{W}{100-\text{sucrose}}$ $= 0{\cdot}25$ is represented by a film consisting of 25 per cent. water and 75 per cent. non-sucrose, and this it will be noted corresponds approximately to the percentage of water and solids in low-grade molasses. The saturation of the water in low Philippine sugars with non-sucrose ingredients would thus be the explanation of why these sugars do not deteriorate. The superior keeping quality of many molasses sugars and the susceptibility of the higher grades of soft refining sugars are also thus explained."

Since the "factor of safety" has proven to be such an altogether trustworthy means of predicting the behaviour of sugar in storage, it is of importance to learn more regarding how sugars can be made to conform to it. It was decided to try this out on a laboratory scale, to learn what the composition of the massecuite must be to yield a sugar the film of which is dense enough to render it safe from deterioration. In connexion with the observation of the behaviour of the sugar in storage, it was thought that it would be of interest to observe whether the molasses would behave in the same manner in storage as the sugar from which it was separated.

Experimental.

In the first experiment a sugar was made from a syrup of the following composition:—

Brix (refract'r)	71·10	True purity..	76·50
Single polarization..	51·20	Factor of safety of syrup..	0·634
Sucrose (Clerget)	54·43		

The syrup was boiled in a 5-litre round-bottom flask under a vacuum of 27 in. After crystallization, it was run through a laboratory centrifugal, and 638 grms. of sugar secured, with a composition as follows:—

Single polarization	82·20	Moisture	7·20
Sucrose (Clerget)	83·90	Sucrose (Clerget) dry basis.	90·40
Reducing sugars	5·70	Factor of safety	0·447

The molasses had the following composition:—

Brix (refract'r)	74·47	Purity	66·90
Single polarization	45·80	Factor of safety	0·500
Sucrose (Clerget)..	50·03		

The sugar and molasses were placed in Erlenmeyer flasks of 300 c.c capacity, and inoculated with different cultures of mould fungi; the flasks were tightly closed with rubber stopper, and paraffined to prevent their contents from drying out. They were placed in the incubator at 32° C. and kept there for one month. The results are given in the following table:—

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[1] *La. Planter*, 1915, **54**, No. 18; *I.S.J.*, 1915, 332.

TABLE I.

*Results of One Months' Incubation of Laboratory-made Sugar No. 1.**

Sample.	Treatment.	Moisture Per cent.	S.P.	I.R.	T.	S.C.	S.C., Dry basis.	R.S.			Deterioration Per cent.	
								SS.	CC.	Per cent.	SS.	R.S.
Control	—	7·9	81·4	12·9 X 2	21	83·06	90·1	10/200	17	5·88		
A (2)	Inocul'd Plat. Loop No. 75	6·45	74·9	12·8 X 2	21	77·97	83·3	5/200	18·5	12·10	6·8	6·22
A (1)	Inocul'd Plat. Loop *A. Niger*	7·75	80·7	13·4 X 2	21	83·92	90·9	10/200	17	5·88		
A (3)	Inocul'd *A. Niger* + ½ c.c. Sterile Water	8·30	79·3	12·9 X 2	21	81·45	88·8	8/200	17	7·30	1·3	1·42

The mould fungi used in this experiment were *Aspergillus niger* and *Aspergillus repens* (No. 75). It will be seen from the above table that the sugar inoculated with culture No. 75 deteriorated very rapidly; when more moisture was added *Aspergillus niger* also caused some deterioration, but nothing like so much as No. 75. The deterioration of the sugar, however, was to have been expected in view of the "factor of safety" being 0·447.

The molasses from the sugar was inoculated with the same culture used on the sugar. The results are given in the following table:—

TABLE II.

Showing Results of Analyses of Molasses from 1st Sirike Sugar.

Sample.	Treatment.	Refract'r Reading.	Corrected Brix.	S.P.	I.R.	S.C.	R. S.			Purity.
							SS.	C.C.	Per cent.	
I	Inocul'd *A. niger*	1·4975	82·83	43·2	5·1 X 2 @ 22°	49·63	7/500	17	21	59·9
Control	—	1·4960	82·37	44·0	5·3 X 2	50·93	7/500	17	21	61·8
II	Inocul'd No. 75	1·4925	80·98	43·6	5·1 X 2	49·96	,,	17	21	61·6
III	Inocul'd *A. niger* + ½ c.c. Sterile Water	1·490	80·04	43·2	5·1 X 2	45·24	9/500	13	21·36	56·5
IV	Inocul'd *A. niger* + ½ c.c. S.W. + Toluene	1·4753	74·37	40·0	4·5 X 2	44·48	9/500	15	18·51	59·8
V	½ c.c. Extract + Toluene	1·4755	74·37	40·0	4·5 X 2	44·48	9/500	14·5	19·1	59·8

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* S.P. = Single polarization; I R. = inverted reading; T. = Temperature °C.; S.C. = sucrose (Clerget); R.S. = reducing sugars.

Now from the above table it will be noted that there was no deterioration of the molasses from the laboratory-made sugar, although it was presumably of identical composition to the film around the sugar crystal. Some evaporation took place during the incubation and the density of the molasses has increased. In the first experiment the syrup from which the sugar was made was evidently of too high a purity to yield a sugar conforming to the "factor of safety." Crystallization evidently took place at a density which permitted of the development of those species of mould fungi capable of causing deterioration. In the following experiment a mixture of equal parts of syrup and first molasses was taken, having the following composition:—

Brix (refract'r)	73·34	Factor of safety..	0·516
Sucrose (Clerget)	48·40	Purity	66·00
Reducing sugars..	17·80		

This was boiled under vacuum as in the previous experiment, and yielded 665 grms. of sugar of the following composition:—

Single polarization	82·80	Moisture	7·27
Sucrose (Clerget)	83·42	Factor	0·432
Reducing sugars	6·40		

The molasses coming off from this sugar had the following composition:—

Brix (refract'r)	77·75	Purity	58·70
Sucrose (Clerget)	45·63	Factor	0·470
Reducing sugars	20·00		

The sugar and molasses were inoculated with the same mould cultures that were used in the previous experiment. The results after one month's incubation were as follows:—

TABLE III.

Showing Analyses of Second Strike Sugar After 1 Month's Incubation Period.

SAMPLE.	Moisture Per cent.	S.P.	I.R.	S.C.	Sucrose (Clerget), dry basis.	R. S.			Deterioration.
						S.S.	C.C.	Per cent.	
No. I.— Inoculated *A. niger*, agar slant	6·6	82·0	12·9 X 2	82·88	88·74	10/ 200	15·5	6·45	—
No. II.— Inoculated No. 75, agar slant	6·45	80·15	6·4 X 4 25·6	81·28	86·88	8/ 200	15·5	8·00	1·9 S 1·4 RS
No. III.— Inoculated *A. niger*, + ½ c.c. Sterile Water..	8·00	82·00	6·4 X 4	82·41	89·50	10/ 200	15·0	6·6	—
No. IV.— Inoculated *A. niger*, + 3 drops toluene	8·10	81·4	6·5 X 4	82·13	89·36	10/ 200	15·0	6·6	—
No. V.— ½ c.c. *A. niger* Ext. + 3 drops toluene	8·7	80·3	6·3 X 4 25·2	81·8	88·3	6/ 200	22·5	7·4	1·00 S 1·8 RS
No. VI.— Control, no Additions	7·5	82·3	6·3 X 4 25·2	82·29	88·96	10/ 200	14·5	6·8	—

It will be noted in the above table that the sugar inoculated with cultures of No. 75 (*Aspergillus repens*) deteriorated quite rapidly, although not so rapidly as in the previous experiment. The inoculation with *Aspergillus niger* again failed to cause any deterioration, although the extract from the same culture did cause a slight loss of sucrose. This confirms what we have previously found to be true, viz., that the extracts of mould fungi are active at densities at which the mould itself may be incapable of growth and development. The extract was prepared in the following manner: The mould was grown in large moist chambers containing Kopeloff's solution with 20 per cent. sucrose. After five days the mould growth was filtered off, washed, and dried between filter-paper. The dried growth was then weighed, ground up with sand in a mortar, and water added in the proportion of 100 c.c. to 21·6 grms. of mould. The mould was thoroughly macerated with the water, and was filtered, first through filter-paper and then through a porcelain filter.

The molasses from the above sugar was inoculated as before, and a series of flasks of sterile cane syrup were inoculated at the same time and from the same cultures in order to test the potency of the cultures. The results of one month's incubation are given in the following table:—

TABLE IV.

Showing Results of Analyses of Molasses from Second Sugars.

SAMPLE.	Refractometer Reading.	Corrected Brix.	S.P.	I.R.	S.C.	Purity.	R. S.		
							S.S.	C.C.	Per cent.
No. I.— Syrup Plat. Loop I. Inoc *A. niger*	1·469	71·46	21·2 X 2 42·4	5·3 X 2 @ 17	48·98	—	7/ 500	— 17·5	— 20·4
No. II.— Plat Loop, No. 75	1·4685	71·21	13·1 X 2 26·2	5·3 X 2 @ 1	36·90	—	5/ 500	14·5	34·4
No. III.— Inoculated *A. niger*, + ½ c.c. H_2O	1·4675	70·81	49·2	5·7 X 2 @ 15·5	54·95	—	20/ 500	10 0	12·5
No. IV.— Inoc. *A. niger*, + ½ c.c. S.W. + Toluene	1·4675	70·81	49·4	5·55 @ 16	54·81	—	20/ 500	10·0	12 5
No. V.— + ½ c.c. Mould Ext.	1·4675	70·89	48·8	5·3 X 2 15·5	53·45	—	20/ 500	9·5	13·4
No. VI.— Control	1·4680	71·09	49·6	5·5 X 2 @ 16	54·96	—	20/ 500	10.6	12 5
Molasses.									
No. I.— Plat Loop, Inoculated *A. niger*	1·482	76·75	40·8 5·1 X 8	2·2 X 2 @ 19	45·17	—	7/ 500	15·5	23·0
No. II.— Inoculated, No. 75	1·482	76·75	40·4	2·1 X 2 @ 17	44·18	—	7/ 500	16·0	22·5

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[1] "A Study of the Inverting Power of Mould Extracts."—*Journal of Bacteriology.*

No. III.—								
Inoculated, *A. niger* + ⅛ c.c. Ster. Water..	1·481	76·35	40·0	2·3 X 8 @ 18	45·06	—	7/ 500	16·0	22·5
No. IV.—								
Inoculated, *A. niger* + ⅛ c.c. S.W. + Toluene	1·4815	76·59	40·4	2·4 X 8 @ 19	46·19	—	7/ 500	16·0	22·5
No. V.—								
⅛ c.c. Extract + Toluene	1·4810	76·43	40·8	2·1 X 8 @ 19	44·51	—	7/ 500	16·5	21·6
No. VI.—								
Control	1·480	76·03	40·4	2·1 X 8 @ 19	44·11	—	7/ 500	16·5	21·6

It will be observed from a study of the above table that while both of the mould species caused a rapid deterioration of the cane syrup, neither of them had any effect upon the molasses. In neither of the two previous experiments did the sugars conform to the factor of safety. Evidently we have to begin with a syrup of still lower purity in order for the sucrose crystals to be enveloped in a film of molasses sufficiently high in density to prevent the growth of micro-organisms. In the two previous experiments we used syrups having purities of 76 and 66°, and obtained sugars having factors of 0·447 and 0·432 respectively. In the following experiment, three first molasses were selected having true purities of 58, 58·7, and 64·6. Their compositions were as follows:—

No. 404.		No. 1202.		No. 1207.	
Brix (Refract'r.)..	74·35	Brix (Refract'r.)....	74·95	Brix (Refract'r)....	74·85
Single (Polarization).	38·8	Single (Polarization).	37·2	Single (Polarization).	41·20
Sucrose (Clerget)....	43·39	Sucrose (Clerget)....	43·95	Sucrose (Clerget)....	48·41
Purity	58·00	Purity	58·7	Purity	64·60

Owing to the low purity of the molasses, they could not be boiled directly to grain, but were boiled blank and the magma poured into large jars and kept in the incubator at 34° C. The magma was stirred several times a day to facilitate development of the grain. After about 10 days, the magma was purged; then the sugar was immediately put into Erlenmeyer flasks and inoculated, the flasks being tightly stoppered with rubber stoppers and paraffined. The following table gives the analysis:—

TABLE V.

Analyses of Laboratory-made Sugars from Sample of Molasses.

SAMPLE.	Moisture Per cent.	Factor.	Factor of Molasses Made From.	Factor Molasses Coming off.	Density of Molasses Coming off.	S.P.	I.R.	R.S. S.C.	R.S. S.S.	R.S. C.C.	Per cent.
Sugar No. 404	6·2	0·302	0·453	0·386	79·02	77·2	6·1 X 4	79·47	8/ 200	18	6·9
Sugar No. 1202 ...	8·14	0·391	0·446	0·334	79·50	83·8	14·5	86·87	9/ 200	18·5	6·1
Sugar No. 1207....	4·47	0·494	0·487	0·339	79·57	87·00	14·3 X 2	89·70	9/ 200	26·5	4·1
La. B.S. Sugar	2·35	0·432	0·358	—	—	93·00	14·7	94·56	20/ 200	23·5	2·12
Cuban B.S. Sugar..	3·15	0·441	0·354	—	—	90·00	7·2 X 4	92·87	20/ 200	22·5	2·22

(To be continued.)

A New British Saccharimeter.

By L. BELLINGHAM and F. STANLEY.

From time to time articles have appeared in the technical sugar press drawing attention to the defects and disadvantages which at present exist to a greater or less degree in the various types of polariscopes designed for sugar work, these criticisms being made from the user's point of view. Recently, suggestions were put forward especially by American sugar chemists[1] in respect of an instrument which should more nearly meet the requirements of those engaged in practical saccharimetric analysis.

Unfortunately, from the experience of the scientific instrument maker, such suggestions are often difficult or impossible to carry out in existing models without very considerable experimental work and expense. It would be advisable as an introduction first to call attention to the imperfections which have been stated to exist in the polariscopes supplied within recent years. The more important of these defects are:—

(1) The cementing medium in the optical elements particularly in the calcite polarizing prisms is not permanent, but sooner or later develops into a cloudy or opaque film.

(2) The edge of the Lippich half prism is fragile and apt to disintegrate, causing a loss of sensitiveness. It also goes out of adjustment.

(3) The long quartz wedge which compensates the rotation produced by the sugar solution gives incorrect measurements at intermediate points on the scale.

(4) Instruments even from the same makers do not give the same readings at the end point of the sugar scale.[2]

(5) The optical elements cannot easily be reached or removed for cleaning purposes.

(6) The stand of the instrument is of a complicated design, allowing syrup and dust to collect in the corners.

All the above statements affect the fundamental and accepted design of polariscopes and may be examined in detail.

1. *The cementing of the optical parts.*—It can be stated definitely that there is no cement known at present which will remain transparent and free from cracks for any length of time in the climate prevailing in countries where sugar cane is grown. For this reason it is usually specified that even ordinary object glasses shall not be sent to the tropics with the component parts cemented but shall be left with free open faces which may be cleaned as required. It is, therefore, quite hopeless to expect a polarizing prism constructed from such a material as calcite to stand with a layer of Canada balsam or linseed oil; and it will be shown later that such a cementing layer may be dispensed with. It should also be remembered that when Nicol prisms were first constructed there was no thought of using them under such trying conditions as exist in many sugar growing districts and no effort has been made to re-design the nicol for tropical use.

2. *The rapid disintegration of the edge of the half prism.*—This is due entirely to the method of cutting the prism from the calcite rhomb. The prism is so cut that the face which contains the sharp edge contains also the crystallographic axis

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[1] *I.S.J.*, 1919, 505.

[2] "If the adjustment of the new scale could be performed by our National Bureau of Standards the various polariscopes of the country would, for the first time, be placed on a strictly uniform basis of comparison. Differences as much as 0·3 have been noticed by the author between the 100° point of different German Saccharimeters supplied to the American trade."– Dr. C. A. BROWNE, in the "Journal of Industrial and Engineering Chemistry," Vol. X, No. 11, page 918.

of the prism, and the edge is liable to break up into a line containing indentations of the same shape as the original crystal rhomb. These indentations may be started in the polishing of the prism, and continued by vibration, or even change of temperature. As soon as they reach the sharp edge of the prism, quite large pieces may fall out and entirely destroy the fine dividing line of the field. If the edge face is arranged to be parallel to a natural edge of the crystal, the surface and edge are permanent.

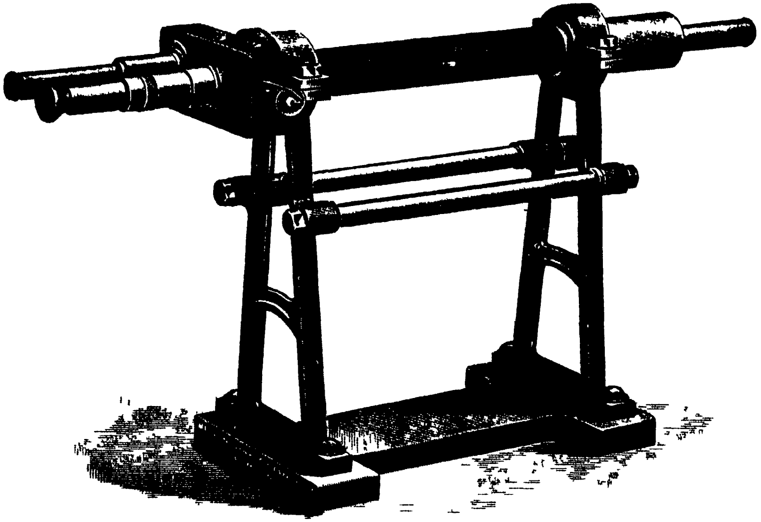

FIG 1.

3. *Inaccuracy of the quartz compensating wedge.*—If a slab of quartz is cut perpendicularly to its axis and viewed in polarized light, it will be found that 80 per cent. of the slabs examined contain twin crystals which show up brilliantly against the darker background of the crystal and would seriously affect the accuracy of the wedge. If more stringent optical tests are then employed, the quartz which was apparently free from defects will now appear to have imperfections over a large area of the surface. In fact, under the tests which are now employed, the writers have never seen an area of quartz really pure over more than two sq. cms. These almost invisible flaws account in a large measure for the fact that very few instruments give correct reading at intermediate parts of the sugar scale; and the longer the wedge employed, the more likely is it to be defective. Further, assuming that the quartz is optically pure, we then have to consider the working of the surface. To give an average accuracy of say 0·02 sugar degrees, and taking the rotating power of quartz to be 21° per mm., the surface of the wedge must be a true plane to within 0·0003 mm., or within one wavelength of yellow light. Such a limit of accuracy is of course easily obtainable on a glass or crystal plate where the thickness is sufficient to prevent distortion in working, but it must be remembered that the wedges are comparatively weak, and that their length renders them particularly liable to distortion.

4. *Variation of reading on different instruments.*—This may be due to several causes such as instrumental errors in the dividing machine, temperature changes during calibration, readjustment of instrument after calibration, variation of light source, etc. This variation has been noted by several observers.

5. *Removal of optical parts for cleaning purposes.*—With the old type of Lippich construction, the slightest deficiency of adjustment of any polarizing element may seriously affect the accurate working of the instrument. If for instance the half shadow angle is changed without the most careful readjustment of the analyzer prism to ensure that both halves of the field are exactly of the same tint at the zero point, the value of a sugar solution measurement may be changed while a quartz control plate may read correctly. For these reasons the Continental makers have probably so designed the instruments that no parts should be removed or re-adjusted after it leaves the factory. This may be quite satisfactory for the user in touch with the factory, but of serious inconvenience to those stationed in distant countries.

6. *Complicated design of the stand.*—The more modern instruments are of much more simple design, but often the convenience of a plain casting is sacrificed for the general appearance.

Description of the New Saccharimeter.

In 1914 the writers started a long series of experiments with a view to eliminating the defects above noted, and to producing a British saccharimeter which should meet the requirements of sugar chemists both at home and in tropical climates. An instrument has now been designed, and is on the market, which, it is hoped, will rapidly displace the old type of instrument. Its essential parts are as follows:—

1. *The Polarizer.*—The polarizing prism is of entirely new construction, no cement film being used. The prism is constructed from two solid rhombs of spar, Fig. 2 (*4* and *5*), and each is so cut with rsspect to the crystallographic axis, and is of such a length of side, that only the extraordinary ray passes out through the prism, the ordinary ray being absorbed at the side. The side of each rhomb is ground away to give the necessary half shadow angle and the desired length of edge to cover the polarizer diaphragm. The face of each of the rhombs is a natural face of the crystal, and one of them contains the sharp sensitive edge.

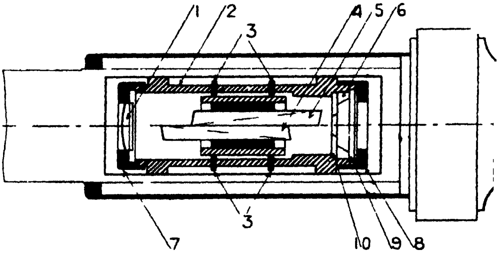

Fig. 2 (Patent applied for).

This construction has most important advantages:—(*a*) The entire absence of cement renders the prism absolutely permanent in all climates. (*b*) The sharp sensitive edge being in one of the original planes of the rhomb, no disintegration can take place, and the edge will maintain its form and sensitiveness. (*c*) The two rhombs being placed in actual contact the dividing edge is invisible and a most sensitive field is obtained. (*d*) The prism cannot go out of adjustment, as is often the case with the Lippich prism.

The new prism with its mounting is shown in diagram in Fig. 2, and, as it will be seen, it forms a separate unit. The prism is protected at one end by the condensing lens *1* and at the other by the glass plate *9*. This polarizing unit is placed in the trough of the instrument through an aperture cut in it and can be quickly removed for cleaning purposes. Separate polarizing units can be sent out by the makers at any time, all units being of standard dimensions.

2. *The quartz wedge compensation.*—The mounting for the quartz wedges in the new instrument is on an entirely new principle (see Fig. 3). The long movable wedge *4* has been reduced to a length of 2 cms., and is circular. The wedge is actually constructed from two opposed wedges of right and left rotation quartz placed together in contact to form a parallel plate. Each pair of wedges is mounted in a suitable container or mounting which may be rotated by set screws 2^1 and 3^1. If the wedges are rotated by a small angle, the effective angle of the wedge will be altered, and also the lateral movement necessary to compensate a given solution of sugar. By this means the wedges may be adjusted after the instrument is finally assembled to give the correct scale length to an accuracy, if necessary, to $\frac{1}{100}$ sugar degree, which adjustment is carried out at present at the National Physical Laboratory, a certificate being given for each instrument. The sugar scale *7* is on glass and is read by transmitted light by a telescope situated at the side of the observation telescope. The scale may be adjusted exactly to cut the Vernier divisions or slightly overlap them and covers a range of — 30 to + 130. The scale is read by a Vernier to 0·1 sugar degree, but the divisions are so fine that estimation may be made to a greater accuracy if required.

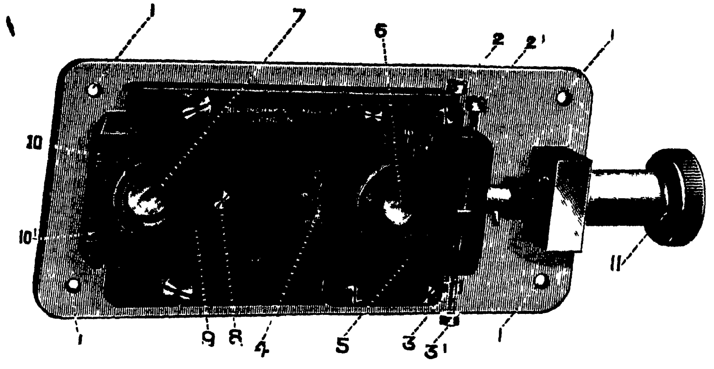

Fig. 3.

The calibration of the scale is based on the international weight of 26·0 grms., but should this standard be altered at a future date, all instruments may be easily readjusted at any testing station or by the user.

The stand.—The mounting of the instrument of the latest model now consists of a single aluminium box casting with smooth sides and curves without corners which can be washed down in a few minutes. The trough of the instrument is of steel and is in one piece from the wedge motion to the end of the polarizer. The trough is held in the box castings by straps at both ends, and if required may be removed. The cover for the trough is revolvable on the trough with sufficient clearance left between the two. As will be seen from this description, this instrument embodies the suggestions which have been made by different sugar chemists. It also fulfils the specifications laid down for the new American polariscope.

Recent Work in Cane Agriculture.

THE SEASON'S EXPERIMENTS ON FIJI DISEASE, MOSAIC DISEASE, AND SMUT OF SUGAR CANE. *H. A. Lee and M. G. Medalla. The Philippine Agricultural Review, Vol. XIV, No. 4, Fourth Quarter, 1921.*

Field Experiments on Fiji Disease.—These experiments were inaugurated to determine the extent of loss, to investigate the reproduction on planting diseased sets, to enquire as to the effect of physical conditions of the soil, and if possible to discover any means of aërial transmission of the disease from plant to plant. The following summaries represent the results obtained:—

(1) Plot of Luzon White planted on February 9th, 1921, with alternating rows of healthy and deceased sets. Observations were made on May 18th and on October 11th, and at harvest in November :—

		Per cent. of Diseased Stools.	
	GERMINATION.	May 18th.	October 11th.
Healthy sets.. ..	71 or 88·75 per cent. ..	7·03 ..	1·44
Diseased sets	48 or 60·00 ,, ..	72·91 ..	100·00
(2) Plot of Cebu Purple as in (1) :—			
Healthy sets.. ..	52 or 65·00 per cent. ..	0·00 ..	0·00
Diseased sets	48 or 41·25 ,, (sic) ..	65·39 ..	100·00
(3) Plot of Luzon White, alternations of six rows healthy and diseased sets :—			
Healthy sets.. ..	71 or 59·16 per cent. ..	5·63 ..	5·63
Diseased sets	60 or 50·00 ,, ..	98·33 ..	100·00
(4) Plot of Cebu Purple as in (3) :—			
Healthy sets.. ..	66 or 55·00 per cent. ..	0·00 ..	0·00
Diseased sets	47 or 39·16 ,, ..	78·72 ..	92·85

Conclusions.—Germination is poorer on planting diseased sets. Diseased cuttings reproduce the disease in any kind of soil and the use of such sets results in total loss. The spread by infection from diseased to healthy plants is surprisingly low, only 3·4 per cent. of all the plants from healthy sets having shown infection at harvest. The losses can therefore be greatly reduced by using only healthy sets.

LA MALADIE DE FIJI DE LA CANNE-À-SUCRE. *Journal de la Station Agronomique de la Guadeloupe. Vol. I, No. 4, Point-à-Pitre, 1921.*

This is a useful short note on the Fiji disease of the sugar cane based on a paper by HASKELL of the United States Agricultural Department. The disease has been reported from Fiji, Hawaii, Australia, New Guinea and the Philippines. It is universally regarded as extremely dangerous. It is the worst cane disease in Fiji, spreading to all the islands and being especially destructive in the northern islands and on rich soil. It is strongly inherited, every piece obtained from a diseased plant passing on the disease. The most constant symptom is the appearance of small galls on the undersides of the leaves and on the soft parts of the stem, but when these appear the plant has usually been infected for a considerable time. The apical bud dies and so do the laterals and even their branches when developed. A marked feature is the crumpling of the end leaves by which affected plants can be detected from a considerable distance. The disease has been traced to a Myxomycete similar to the Plasmodiophora causing "club root" in cabbages; and it is suggested that, as in that case, the fungus may live for a considerable period in the soil from whence it penetrates the root hairs of the sugar cane, passes up the fibrovascular bundles and infects every part of the plant. It may thus be carried from one part of an estate to another by means of odd pieces of cane. Considering the wide dismay caused by the appearance of this new disease, the most stringent regulations have been enacted in all sugar cane countries against the importation of pieces of cane, soil or other material which might harbour the spores or living body of the Myxomycete.

ANNUAL REPORT ON THE WORKING OF THE BRITISH GUIANA SUGAR PLANTERS' EXPERIMENTAL STATIONS COMMITTEE FOR THE YEAR ENDED 30TH SEPTEMBER, 1921. *Journal of the Board of Agriculture in British Guiana, XV, 3, July 1922.*

This Report, written almost entirely by J. CRABTREE, the Superintendent, is of considerable interest, as showing the lines along which the sugar planters are working in British Guiana. As is natural, the actual work during the year was practically confined to the new station at Sophia, although an extended tour was made by the Superintendent throughout the cane growing tract, to gauge the conditions of the industry and obtain the necessary information for formulating the policy to be adopted. Much time was devoted to the collection on the station of the numerous scattered varieties and seedlings found in the country, to form a nucleus to work upon. While the collection at the Botanic Garden forms the main mass of cane varieties, we note that the various concerns, which have privately and with some success been engaged in raising their own seedling canes, have placed these freely at the disposal of the Superintendent. Besides this, a number of other countries have been indented on, and varieties have been received from Barbados, Trinidad, Mauritius, Queensland, Egypt, St. Croix, Cuba and San Domingo. Because of mosaic no canes are allowed to enter the country, except through the Botanic Gardens and the Experiment Stations, and the various imported kinds are being grown there under quarantine conditions. The guiding principles as to distribution may be judged by the treatment accorded to the seedlings obtained from the Botanic Garden, most of which have, presumably, been tested for a number of years. These were laid down in plots varying from 0·17 to 0·007 of an acre, and the surplus was distributed to 11 estates for trial on a field scale, to the extent of 60 tons of tops during the year.

The importance of this line of work in British Guiana may be judged by the fact that D 625, the standard cane, occupies roughly three quarters of the cane-growing area: if by any chance this variety suffered a reverse the condition of the industry would be little short of disastrous. Experience in the past has demonstrated the long way to be travelled before any new kind can be evolved to take the place of a standard variety, and the raising of fresh seedlings has therefore been started at once. D 625 is a hardy cane of low sucrose content and the objective at present is to raise seedlings with moderate vigour and moderate richness of juice, from among which one or two may be obtained to act as a reserve in case of need. Introductions from other countries are not likely to be of much use except as parents, for the simple reason that British Guiana seedlings are not in great demand elsewhere: the Superintendent somewhat sweepingly remarks that no country in the world wants British Guiana seedlings.

It is recognised that the modest aim mentioned above is due to the very low grade of cultivation in the cane fields, and this brings into prominence the second line of work to be entered upon. The general conditions of labour and cultivation in British Guiana cane fields are fairly well known, and an interesting comparison is entered into between the local treatment of the cane and that in Java, Cuba and Hawaii. In Java, it is pointed out that land is dear and restricted, but labour is cheap and abundant: intensive cultivation is therefore in vogue and the maximum production is obtained by manual labour. In Cuba the land is plentiful and fertile (much of it being new), but labour is dear and scarce : therefore the cultivation is extensive and cane-farming is widely spread. In Hawaii, lastly, land is comparatively dear and labour deficient and costly, but fairly efficient: the cultivation is intensive and the most modern labour-saving implements are in use. In British Guiana land is cheap, but if the sea defences and canals and drains are included it becomes dear. Labour is not so dear as in Cuba and Hawaii but, considering the possibility of an expanding rice growing industry, had better be classed as dear. Intensive cultivation is thus indicated. There are two ways of obtaining this in the conditions, namely, in cane-farming and improved implemental cultivation. The former is really cheaper labour, on the principle that a man working for himself does it more thoroughly and efficiently than when working for others. But cane-farming, the Superintendent remarks, has not been a success in British Guiana, "as everybody knows". It is certainly not suited to the coast lands where the heavy expenses of sea walls, drainage, etc., have to be incurred. The place for this form of production is further inland, up the riverine lands where the alluvium is high and naturally drained. Implemental cultivation is the only course left. But there are special difficulties in the way, and it is little short of a disaster that the trials, which had been commenced on almost every estate, have been summarily stopped because of financial stringency. The experiment station cannot undertake it at present unless its staff is increased, and it is suggested that it might be done by the planters along co-operative lines, the Government subsidizing the work substantially because of its universal importance.

The station at Sophia is of course still in its infancy, and at the end of the year under report there were 34 acres cultivated, 10½ cleared and 65 in bush. A detailed balance sheet is appended by the Committee.

MALADIES ET INSECTES NUISABLES À LA CANNE-À-SUCRE À LA MARTINIQUE. *A. Buffon. Bulletin de l'Association des Chimistes de Sucrerie et Distillerie de France et des Colonies. Tome XXXIX, No. 12, Juin 1922.*

This paper professes to summarize the pests and diseases of the Martinique sugar cane fields. Of the latter, the root disease is considered the only really important one. It is credited, as usual, to various species of Marasmius, especially *Marasmius sacchari*. The remedies suggested are those suitable for a parasitic fungus, collecting and burning all diseased pieces and even burning the whole crop where the attack is severe, while in sporadic cases it should be sufficient to dig a trench round the affected area and thus segregate it. Also treating the sets with Bordeaux mixture and tarring the ends, and, lastly, trying to improve the health of the plants by better selection of seed, cultivation, and drainage. No reference is made to the more recent work on this disease. Red rot and pineapple disease appear to be of less importance and are described as wound parasites and treated accordingly. Mosaic is possibly present, as the author thinks he saw it, but was unable to obtain specimens for examination in order to determine it definitely. Fiji disease was reported from one locality but it is not thought that this disease is present at all in Martinique.

The insect pests occupy a much larger section of the paper. The pride of place is given to the moth-borer (*Diatraea saccharalis*) which extends throughout the island and causes great damage. Control is however regarded as simple, if only the planters would collect the eggs and cut out the dead hearts. It is somewhat curious that the shot-borer beetle (*Xyleborus perforans*) is placed side by side with the moth-borer. "Il creuse des galleries analogues à celles du charançon perceur. Ses méfaits sont à peu pres equivalents." As regards remedies for these borers the author relies on BASSIÈRES, who recommends covering the ratoons with earth as soon as possible after harvest to prevent the deposition of eggs, and delaying the taking out of the stumps until six weeks later. If these are then burnt along with all dead pieces a vast number of borers will be destroyed before they have reached maturity. The Coleoptera include a great number of cane pests, the white grubs being the larval forms of *Lachnosterna paraellela* and *patruelis*, *Ligyrus tumulosus* and *Cyclocephala tridentata*. Diaprepes is extremely abundant in Martinique, and has white grubs without legs, which devour the cane roots. Young plantations suffer most and considerable numbers of these grubs can be collected at the bases of the cane clumps. *Scapteriscus didactylus* is described as a terrible enemy although fortunately localized: it disdains heavy clay lands and is chiefly found in light, well drained areas in the north east of the island. The eggs are deposited in galleries in which abundant food is stored. Damage is chiefly incurred by the adults eating all the cane roots encountered in digging their burrows. They are very difficult to eradicate, managers of estates affirming that, in places where they have obtained a firm hold, it is sometimes necessary to clear them out as many as eight times before they are destroyed. A certain amount of success has been attained by injecting carbon bisulphide, and poison baits are also useful. Of less importance are the sucking insects. *Delphax saccharivora* is held in check by natural enemies. Mealy bugs (*Pseudococcus sacchari* and *calceolariae*) are very numerous on the cane stems and occur chiefly in damp situations, but these and others are of little account. The article is written in popular style and finishes with estimates of damage (chiefly in other countries): the author calls on planters to institute a campaign against the insect enemies in their fields.

REPORT OF THE AGRICULTURAL DEPARTMENT OF ANTIGUA, 1919-20. *Imperial Department of Agriculture for the West Indies, Barbados, 1921.*

The season proved very favourable to cane growth up to December, after which the weather was very hot and dry, though this probably helped to ripen the canes. The output at Bendals and Gunthorpes was better than in the previous year, the tonnage of sugar being respectively, 2453 for 1544 and 9739 for 7316. The exports for the year were:—Sugar crystals 11,239 tons, muscovado 943 and molasses 3203 puncheons. Some 72,626 cane cuttings were distributed to the planters during the year.

Pests and diseases.—The grubs of the brown hard-back (*Lachnosterna spp.*) were again present in large numbers in the sugar cane and corn fields, and especially so in the central plain of the island. The life cycle, judged by observations on plant and ratoon fields, appears to be about one year in duration. There appears to be a definite relation between the attacks of root disease and white grub. There is no doubt that the grubs do injure the young ratoon shoots, but the total loss would be greatly reduced if the root disease could be controlled. As an example of the relative importance of these two plagues, a case is quoted, in which two plants were selected from a ratoon field, one apparently healthy and with 15 good canes and the other obviously sickly and with only eight canes. These were dug up and examined. The healthy plant showed mere traces of the fungus mycelium and 61 grubs were collected round its base. The unhealthy plant was found to be badly attacked by root disease and only 35 grubs were obtained. Similar results were met with in the fields of plant cane. As a method of control an experiment with pigs was tried in a field, where it was estimated that 100,320 grubs were present to the acre. A moveable pen capable of enclosing nine stools was placed in position and six pigs were let in for two days. The pen and pigs were then removed and the stools dug up and examined. Dug to a depth of 10 in., only eight grubs were found per stool. But, previous to the experiment, heavy rain had compacted the soil, or probably even these would not have escaped; it was calculated that 49 grubs were devoured per stool. The introduction of pigs should thus prove a useful measure of control. Natural enemies were difficult to find; only *Tiphia parallela* was fairly common in the fields, but its action was imited, as only three grubs were found to be parasitized in 2500 examined. Root disease was again common throughout the island, causing considerable damage; pineapple disease was not reported from any estate, but *Colletotrichum falcatum* was fairly common and probably was the cause of several fields failing to be established. B 4507 showed itself to be very susceptible to this disease. Weevil borer and moth-borer were found in most fields but did not cause much damage, while *Exophthalmus exuriens* was also fairly common but not considered harmful.

SUGAR CANE CULTIVATION IN MYSORE. *Leslie C. Coleman. Mysore Economic Journal, April 1920, pp. 244-257.*

In this paper the author gives a concise and interesting account of the sugar cane industry in this native state of India. The limiting factor, as is usual in South India, is the irrigation facilities, and, in spite of the fact that the river Cauvery passes through the country, the great bulk of the cane fields are dependent on tanks for their water supply. As few of these are capable of containing a full year's supply, the area under sugar cane does not show any tendency to increase. The varieties grown are detailed and described; and it is evident that the juice obtained from the local canes is extremely rich in sucrose and has little glucose. The system of cultivation, pests and diseases and existing irrigation works are discussed, and sections are added on manufacture and the possibility of the installation of central factories. There does not appear to be much likelihood of the latter becoming established in the near future, for reasons duly set forth.

DE WAARDE VAN DE VERSCHILLENDE STIKSTOF-MESTOFFEN VOOR DE SUIKERCULTUUR OP JAVA. *J. Kuyper. Mededeelingen van het Proefstation voor de Javasuikerindustrie. Jaargang 1922, No. 3.*

Under the supervision of the experiment station at Pasoeroean, field trials have been conducted for many years on a great number of sugar plantations, as to the relative merits of nitrogen fertilisers. Sulphate of ammonia, being in general use (averaging 380 lbs. per acre), is taken as the basis for comparison. In all the experiments the same weight of nitrogen was given in the different manures. During the last ten years 162 comparisons have been made between sulphate of ammonia and nitrate of soda. These two fertilisers proved to be of equal value, but the sulphate has been found to be preferable because it is of a less hygroscopic nature. Nitrolim or calcium cyanamide was not so good as ammonia. In about 100 field trials, the latter gave equal results in 24 cases and superior in 53. "Ammonium-sulphate-saltpetre" imported from the Badische Anilin und Soda factory proved to be too hygroscopic for the conditions of the rainy season in the tropics. Urea imported from the same factory, on the other hand, gave the same results as the sulphate in 12 field trials, and is accordingly regarded as a useful substitute. A detailed study was made of ground nut cake (*boengkil*). It proved inferior to ammonium sulphate; and a combination of the two manures gave better results than the cake alone. Ground nut cake is better for light than heavy soils.

C. A. B.

Steam Turbine Driven Centrifugals.

An Interesting American Development.

(Contributed.)

During the last five years considerable improvements have been made in centrifugal machines used for drying sugar and other crystalline substances, the main one being the development of the direct electrically-driven machine which is now generally considered a perfect success and is being adopted by numerous refineries and raw sugar factories.

But in many chemical works it is impossible to use the electrically-driven machines on account of the corrosive fumes and vapours which attack the motors and other electric fittings even when they are acid proof. In consequence such works are led to resort to belt-driven or water-driven machines. However, the corrosive fumes are also very deleterious to belts, and that eliminates everything but the water-driven machine.

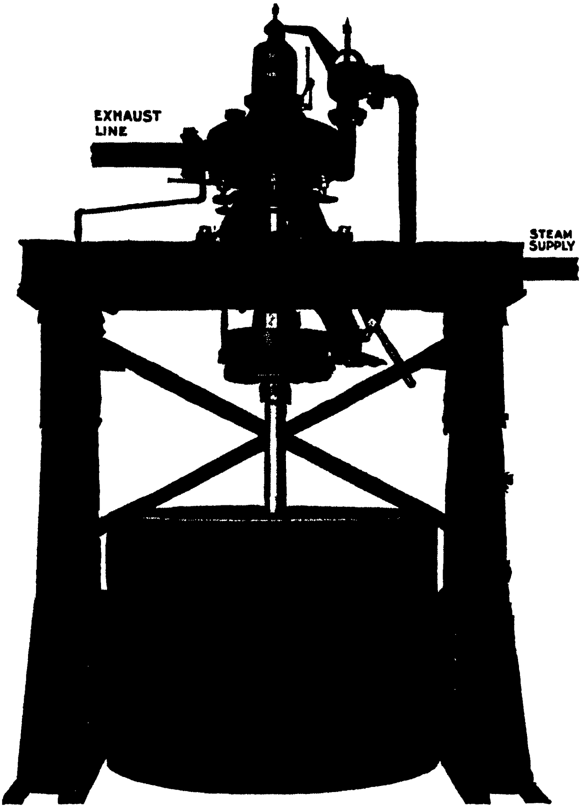

Fig. 1.—Terry Steam Turbine attached to Cresson-Morris Centrifugal.

Again, in many sugar factories, especially those of small dimensions, the electric plant consists generally of a small lighting plant; and the introduction of a set of electric-driven centrifugals usually means the installation of a special electric plant to drive them.

Consequently, the alternative has been suggested of using a steam turbine drive for the centrifugal units. But hitherto, on account of the slow speed of the baskets of the centrifugals as compared with the high speed of steam turbines generally, it has been necessary to use reduction gears between the turbine and the basket, an obviously detrimental feature.

Under the direction of Mr. D. J. Lewis, Jr., and Mr. A. S. Morris of the Cresson-Morris Company with the assistance of the engineers of the Terry Turbine Company, a steam turbine centrifugal has lately been developed that overcomes this obstacle and will give the same efficient results as the electrically-driven machine. The Terry Steam Turbine Company's engineers have in fact designed a vertical turbine which when attached to the Cresson-Morris electrically-driven centrifugal in place of the usual electric motor is able to handle the final speeds of 720 to 1150 revs. per min. satisfactorily when direct-coupled. In the accompanying cut (Fig. 1) we give an illustration from a photograph of this combination.

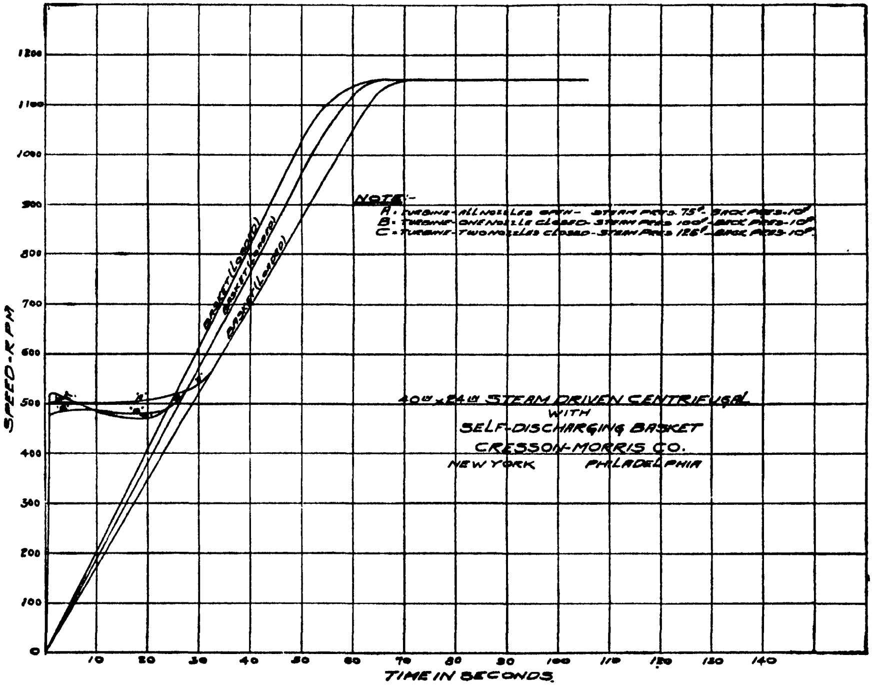

Fig. 2.—Chart of Acceleration of 40 in. Basket.

The turbine is connected to the spindle of the basket by means of a slip clutch, and on starting the machine the turbine is able to get up a speed varying from 400 to 600 revs. per min., according to the grip of the clutch, before starting to move the basket, and the final speed is regulated by means of a governor attached to the steam turbine. The throttle valve for operating the turbine is interlocking with the brake mechanism, both being operated by the same handle, so that it is impossible to get the brake and the motor on at the same time.

The question of speed regulating during acceleration due to the variable pressures existing in many plants has been allowed for by the number of nozzles installed in the machines. On examining the accompanying charts (Figs. 2 and 3) it will be seen that the three lines representing steam pressures of 125 lbs., 100 lbs., and 75 lbs., all working against a back pressure of 10 lbs., are all very close together.

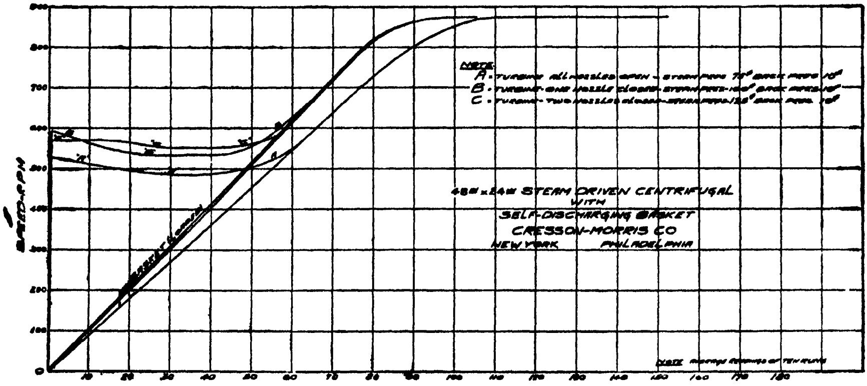

FIG. 3.—CHART OF ACCELERATION OF 48 IN. BASKET.

The experiments on the machine have been of a practical nature, having been made both on a 48 in. and a 40 in. self-discharging machine loaded under varying conditions; and the Cresson-Morris Co. is, we gather, prepared at the present time to furnish these machines singly or in batteries with any kind of basket or any requirements in regard to acceleration, final speed, and length of cycle. In fact, the machine has been arranged so that it can, so to say, be hooked on to the boiler of the factory and meet any condition that may arise either in a raw sugar factory, a refinery, or a chemical works.

American Commerce Reports.[1]

CUBA.

The dominating factor in Cuban prosperity is the production and marketing of its immense sugar crop, upon which banking and credit transactions are primarily based. Any prolonged depression in the sugar market, therefore, such as the one which has prevailed during the last year and a half, affects all phases of Cuban commercial life. Next in importance to the sugar crop is the tobacco crop, its prominence being due, however, more to the fact that it provides employment for a larger number of people than that its value approaches that of the sugar crop. Coffee, cacao, and tropical vegetables and fruits are also grown in abundance in Cuba, but not in quantities sufficient to figure prominently among its exports.

The year 1921 was probably more disastrous financially to Cuba than to any other of the Latin American Republics, and this condition is reflected in United States exports to that island, which fell in value from $515,208,731 in 1920 to $187,726,179 in 1921. During the past few years our chief exports to Cuba have been automobiles and accessories, including tyres; railway equipment; sugar machinery; building materials, of which lumber was the principal item; cement; structural iron and steel, and other iron and steel products, such as nails, pipes and fittings, sheets and plates, tin plate, and wire; cotton textiles, principally bleached and printed goods; boots and shoes; and a wide variety of foodstuffs.

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[1] Culled from "Commerce Reports," published by the Department of Commerce, Washington. In many cases these are abbreviated here. Tons quoted are *short* tons of 2000 lbs.

Exports of all these articles fell off during 1921, Cuban requirements having been cut down to bare necessities.

Decreased Imports from Cuba.

A discussion of our imports from Cuba resolves itself into a discussion of imports of cane sugar, since that commodity represents, on an average, 80 per cent. of our total imports from Cuba. In quantity the amount sent to the United States during 1921 fell only about 10 per cent. under the previous year's shipments, but the slump in prices, which continued steadily up to December, when sugar was quoted at 2·39 cents per pound, resulted in a drop of the value of the total sugar imports from approximately $669,000,000 in 1920 to only a little over $194,000,000 in 1921. This would seem to represent an enormous loss, but a comparison of the 1921 figures with those of 1914, when practically the same amount was shipped, shows that the 1920-21 crop brought nearly twice as much as the last pre-war crop.

Foreign Competition in Cuba.

The decline in our exports to Cuba during 1921 is of interest, as it indicates the economic depression which prevailed in that country. Foreign competition has had little chance to develop in Cuba. The advantages afforded by the Platt Amendment, the 20 per cent. preferential tariff conceded to American goods, the proximity to the United States, and the influence of American capital in the sugar industry effectively guarantee American goods a receptive market. Fitful efforts have been made from time to time by foreign firms to enter the Cuban market, but have been effective only in a few special lines, such as wines, toilet articles, etc. Notwithstanding the severe crisis through which Cuban business passed during 1921, our exports during that year were more than double the 1914 exports, even after due allowance is made for the generally higher level of prices of manufactured products.

Improvement in Cuban Conditions.

At the close of 1921 the outlook in Cuba was one of unqualified gloom. Sugar prices had fallen steadily from the record of 23½ cents in 1920 to 2 cents and less; the decline in general and property values had been tremendous, and the period of deflation consequently painful; and the native banks were in the hands of a liquidation commission. Moreover, as the producers had been unable to recover the cost of production from their 1921 crop, a heavy surplus had been carried over, and prospects for the coming year were considered among the worst in the history of the country. The situation was further complicated by the accumulation in Cuban bonded warehouses of merchandise amounting to an invoice value of $60,000,000, which had not been delivered for various reasons, including inability or unwillingness of the Cuban consignees to pay; the confusion resulting from the congestion period when goods were lost; and refusal to take the goods, due to misunderstandings between shipper and consignee.

Conditions improved somewhat in the early part of 1922, with the strengthening of sugar prices, which have been climbing slowly back to a point that will allow some margin of return over production costs, and on the reports of an invisible shortage of sugar in the United States and a new interest in European markets which are forced to look to the West Indies and other sugar-producing regions to supply stocks formerly obtained from France and Central Europe. Through a series of representations on the part of the United States Government, underwriters, textile exporters, and other interests, the Cuban Government has been prevailed upon to take action resulting in the liquidation of stocks in the custom houses by July 1st, 1922, either through reexportation, sale at auction, or acceptance by consignee. Adjustments of outstanding accounts are gradually being made, but it is expected that payments in some cases will extend over a period of two years or more. The banking situation is still bad, and 13 of the 17 banks which came under the supervision of the liquidation commission are still unable to function. All bank transactions, therefore, are in the hands of the four banks which have been reorganized, the foreign banks and the still solvent domestic institutions which by a conservative policy and outside support, were able to weather the storm. In addition to the reorganization of the banks, better banking laws are now being formulated by a committee appointed for that purpose.

Despite the pessimism manifested in business circles, a comparison of present conditions in Cuba with those of a year ago shows a steady if somewhat slow improvement. Among the more encouraging factors might be mentioned the improvement in the sugar situation; the increasing exports of both sugar and tobacco at prices which allow a fair profit; the reduction in outstanding private accounts; and the liquidation of stocks in bonded warehouses. Latest reports received from the island indicate that, while the market is not in a healthy condition and the return of normal conditions as a whole can not be expected within the near future, the crisis has been passed.—[*American Trade and Economic Review.*]

THE GERMAN SUGAR INDUSTRY, PRESENT AND FUTURE.

Germany for years has been the leading beet sugar producer of the world. Second place in world production, formerly occupied by Russia, has now been taken by the United States. With production cut approximately in half by the war the recovery of the German sugar industry is a matter of practical concern to American beet growers and sugar refiners.

Germany attained a pre-war producing capacity of 2,700,000 short tons, which meant an annual surplus for export of approximately 1,000,000 tons. (In 1913 the total sugar exports amounted to 1,110,073 tons, of which 838,583 tons went to the United Kingdom.) Great Britain was Germany's best sugar customer, taking as much as 750,000 tons in a single year. For the past seven years Germany has been entirely out of the sugar export trade, and during the last season was under the necessity of importing 150,000 tons or more to cover absolute domestic requirements. The annual loss to the export trade of 1,000,000 tons of German sugar is a matter of capital importance to the industry the world over. It is of interest, therefore, to examine what has befallen the German sugar industry and to inquire about the outlook for its recovery.

Loss of Beet Lands.

Within the territory turned over to Poland by Germany under the terms of the peace settlement were 296,400 acres of beet sugar land. Indeed, some of the best beet sugar soil of the old empire was in the Posen region and the so-called Danzig corridor. With the territory there passed also to Polish control two sugar refineries and upward of 30 sugar factories. Experts estimate that 700,000 tons of potential sugar production has been lost to Germany by territorial cession out of the 2,700,000 tons of pre-war sugar capacity. As a matter of fact, the amount of sugar actually produced in 1913, on soil turned over to Poland, may be estimated at 450,000 tons. It is hardly fair to conclude that Germany has lost as much as 700,000 tons of sugar-producing capacity, inasmuch as this higher figure represents the potential rather than the actual production at the outbreak of the war. The point may be made that the change in frontier has not necessarily lessened the European pool of sugar wealth. In other words, is not Poland's productive power increased in like measure with the losses sustained by Germany through cession of beet sugar land? Such expectations have not been justified by results. In the 1920-21 campaign, Poland produced on former Prussian soil 102,733 tons, and last season only 95,092 tons—this in comparison with 450,000 tons produced in the same area in 1913 under German control. Probably no other agricultural industry the world over was so highly organized as the German sugar industry.

Labour Difficulties and Soil Deterioration.

Aside from territorial losses, beet growing has been further curtailed in the area now included in Germany, the acreage having fallen in the post-war period about 21 per cent., while yields per acre have fallen off approximately 30 per cent. The area now under beet cultivation is 8·3 per cent. larger than last year, with an outlook for an increased crop of 200,000 to 250,000 tons. The improvement over last year, while due in some measure to increased acreage, is principally accounted for by more seasonable conditions. Last year's severe drought caused a short crop of beets, although increasing the unit sugar content. The two main factors that check rising production are labour difficulties and soil deterioration. The prevailing high wages paid industrial labour have bred restlessness and discontent among the German farm hands. Wages are high as compared with the pre-war scale, and it is difficult to secure floating Polish labour for work in German beet fields. Beet cultivation requires an excessive amount of hand labour, and the heavy seasonal demands for labour were met to a large extent in pre-war times by bringing labourers, principally women, across the border for work in the beet fields. Poland having now become an independent State, it is difficult for labourers to secure passports for temporary work on German soil.

The deterioration of the German beet growing soil is connected with reduced imports of oil-cake and phosphatic fertilizers. The principal item in Germany's imported cattle feed was formerly Egyptian cotton seed, which, while affording a support to the German live-stock industry, contributed indirectly to soil fertility through the increased supply of rich animal manures. Germany, while formerly possessing almost a monopoly of the world's known deposits of potash, has to depend upon foreign sources for supplies of phosphoric acid in portable form. In 1913 German agriculture disposed of 630,000 tons of phosphate. During the war, from the harvest of 1915 on, the use of Thomas' meal fell off 30 per cent., superphosphate 90 per cent., bone meal 75 per cent The amount of phosphoric acid of all kinds used annually during the war was only 291,000 tons, as compared with 630,000 tons in 1913—that is to say, only 46 per cent. In 1919 the quantity had been reduced to 231,000 tons, and in 1920 to 137,000 tons. In 1921 the supply rose to 268,000 tons. At best the amount of phosphoric acid now available for German agriculture is less than half of what it was before the war. Certain losses and privations are not cumulative. If a person has only half enough sugar for normal consumption in one year, this does not mean that he needs twice as much the next. In the case of foods needed by the soil losses are of a cumulative nature, and the deprivation suffered by the German soil during the war in the matter of phosphatic food would not be made up even if the same amounts were being applied to-day as before the war. Taking acre for acre, the German soil was receiving in portable phosphoric acid about 44 pounds in 1913, while to-day not more than 22 pounds are available. German farm experts estimate that an average crop of sugar beets takes from the soil about 110 pounds of phosphoric acid, while a very heavy crop drains the soil of as much as 176 pounds.

German Sugar Consumption.

While German production has been thus declining, consumption at present shows a distinct tendency toward expansion. This is an important factor in relation to the ressumption of sugar exportation. It is interesting to observe that while big drops have occurred in the German per capita consumption of bread and meat, both having declined certainly more than 30 per cent., a marked tendency toward expansion in the per capita consumption of sugar is evident. Indeed, in the case of sugar the increase would have proceeded apace had not the demand outrun domestic supply, and further expansion been checked by the high price of imported refined sugar. German sugar consumption is now approximately 1,450,000 tons per year. If 10·5 per cent. is added for population lost through the peace settlement, present-day consumption is just about on a par with pre-war, or the equivalent of 1,600,000 tons. It may be considered remarkable that the consumption of a relatively high-priced, condensed food such as sugar should be maintained at a time when severe curtailment is being made in German food consumption. Even in England the consumption of sugar has not risen to pre-war levels, the figures showing 1,732,000 tons for 1913, and 1,500,000 tons estimated for 1922. The explanation of increasing sugar consumption in the case of Germany is found mainly in the shortage of animal fats and meats. With milk production ranging at only about 30 per cent. of normal, and with butter extremely scarce and high priced, jams, marmalades, and artificial honey spread on bread are being used as a substitute for butter, margarine, lard and other animal fats. Owing to the meat scarcity nearly all classes are eating more chocolate. The workmen in the factories take along a bit of chocolate in the place of meat as an item in their midday lunch. The increased use of artificial honey is directly connected with the shortage of meats and fats.

Expansion of Artificial Honey Industry.

Artificial honey is made from refined sugar, either cane or beet, and contains about 80 per cent. sugar, the rest being water and honey flavour artificially conferred. Pre-war peak production was reached in 1905, the industry declining by 1913 to a point where the factories were working only at about 25 per cent. capacity. The shortage of meats and fats during the war stimulated the industry, which became very prosperous until Government control of sugar limited the amount of raw material allocated to the honey industry. However, despite all difficulties, post-war production exceeded the pre-war from 300 per cent. to 400 per cent. At present the factory operations are embarrassed through lack of sugar and are unable to supply more than a fraction of the demand for artificial honey. There are from 40 to 50 large factories with about 150 smaller "cookeries" so called. The annual production of honey is about 50,000 tons, which means a consumption of about 40,000 tons of refined sugar. Assuming that the production of sugar in the coming campaign will exceed that of last year by 250,000 tons, which is doubtful, the entire outturn will not surpass the actual consumptive needs of the country. Even if the highest hopes are anticipated and a crop of 1,550,000 tons is realized, the country will still be 1,000,000 tons short of the average pre-war production.

Outlook for the future.

The question of how capable Germany is of recovering her former export capacity is purely and simply a matter of speculation. At the same time an intelligent forecast may be made as to the future development of the German sugar industry. It is clear that the consuming needs of the country are not short of 1,450,000 tons at the present time, while recent productive capacity has been somewhat below this level. Putting the yields for the autumn campaign at 1,550,000 tons it may be assumed that no surplus will be available for export from the coming crop. Even if there were added to the coming crop the 450,000 tons lost through the transfers to Poland, there remains a gap of 600,000 or 700,000 tons to be made up by Germany as at present constituted before it can arrive at pre-war productive capacity. How many years will it take to increase production by this amount? There are certain variables in the equation, such as the future price of sugar, availability of cheap labour, and the restoration of soil fertility. The stimulus to production derived from higher prices may be neutralized by a species of State control, which will fix domestic prices while laying an embargo on export. Just this sort of thing has already been done in the case of bread grains, where the Government takes a certain percentage of the farmers' wheat and rye at cut-rate prices, while forbidding exportation. Such a course would have a chilling effect upon the beet sugar industry, as the costs of farm wages and fertilizers have already greatly increased over pre-war scales.

Imports of phosphoric acid are increasing, but as yet there has been no turn in the decline of animal manures. German cattle have not been severely reduced in numbers, but the condition of the animals is poor, as the oil-cake, formerly the mainstay of the cattle industry, is not to be had except in limited quantities at the prevailing rates of exchange. Such authorities as the agricultural expert of the German potash syndicate, the editor of a leading Berlin sugar journal, and representatives of the trade at Magdeburg, are in substantial agreement that it will take at least 10 years for the German sugar industry to get back to its pre-war position. Even having recovered this position the export capacity of the country will have been reduced by about 450,000 tons. Therefore, the ability of the country to throw 1,000,000 tons of sugar annually on the world market is a thing of the past; 500,000 tons now seem to represent about the maximum effort of which the country is capable, and even this must be deferred for some years to come. It may be noted in conclusion that the country possesses sufficient factories and refineries at the present time to handle 30 or 40 per cent. more sugar beets than are being produced. The difficulty is with the agricultural, rather than with the manufacturing, side of production.

Publications Received.

(1) **The General Principles of Chemical Engineering Design.** By Hugh Griffiths. (2) **Materials of Chemical Plant Construction: Non-Metals.** By Hugh Griffiths. (3) **The Weighing and Measuring of Chemical Substances.** By H. L. Malan and A. I. Robinson. (4) **Chemical Works Pumping.** By Norman Swindin. (5) **The Flow of Liquids in Pipes.** By Norman Swindin. (Benn Brothers, Ltd., London). Price: 3s. each net. 1922.

These Volumes comprise the first five numbers of the "Chemical Engineering Library." No one will deny that there is ample scope for practical books on various aspects of the technique of chemical works management design and erection, the existing literature on the subject (in English at any rate) being of a rather general nature, and often quite inadequate in regard to matters of importance. Recognizing this deficiency, the publishers are issuing this series of small works on topics of chemical engineering, which they state have been specially written by practical men to meet the requirements of the industrial chemist and engineer. In the first, the factors going to the operation of a successful chemical plant are discussed. In the second, data is given respecting bricks, stones, timber, rubber, ebonite, leather, and other materials. In the third, the principles of weighing and measuring are discussed, this being a volume that probably will appeal to the sugar factory and refinery engineer, since it deals with methods of computing the amount of liquids (e.g., juice, maceration water, molasses) and solids (e.g., finished sugar.) In the fourth, there is a deal of useful theoretical and practical information on the transference of liquids and semi-liquids by means of pumps. And in the fifth, the reader is given instruction on the law of resistance to flow of liquids, and the laws of viscous flow, matters of importance in considering the design of pipe lines for irrigation and the long distance conveying of other liquids than water. These volumes impart much useful information; are suitably illustrated; and their price is certainly moderate.

An Introduction to the Chemistry of Plant Products. By Paul Haas and T. G. Hill. Vol. II. (Metabolic Processes.) Third Edition. (Longmans, Green & Co., London and New York.) 1922. Price: 7s. 6d. net.

Some months ago we drew attention to the publication of the first volume of this third edition of Haas and Hill's valuable work on the chemistry of plant products.[1] This second volume gives a sketch of the life processes of plants, and considers in some detail the more outstanding problems from the chemical point of view of the building-up by the plant of sugars and other carbohydrates of fats, and of proteins, giving also an account of the present position of our knowledge of plant respiration, *i.e.*, the production of energy for the maintenance of the life of the plant, and of growth, the balance between these constructive and destructive processes. Volumes I and II form a really excellent monograph for chemists and agriculturists on plant biochemistry, summarizing as it does information which hitherto has been attainable only by a somewhat tedious search through the literature of the subject.

Mechanism of Dust Explosions. Guy Taylor, H. C. Porter, and E. C. White. Report No. 2306. U.S. Bureau of Mines, Washington, D.C., U.S.A. 1922.

The Story of Preserved Food. Edited by Ernest H. Taylor. (Angus Watson & Co., Ltd., Newcastle.) 1922.

Contents:—Introductory. Canned Foods (Fruits, etc.). Home manufactured Goods. Evaporated and Dried Fruits. Various.

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[1] *I.S.J.*, 1921, 223.

Trade Notices.

Ploughs and Implements for Tropical Cultivation. (Ransomes, Sims and Jefferies, Ltd., Orwell Works, Ipswich.) 1922. Obtainable on application.

Messrs. Ransomes, Sims & Jefferies, Ltd., is an old-established firm specializing in ploughs and other implements for use in the cultivation of sugar, tobacco, cotton, and other crops produced in tropical countries. They have always been in close touch with the conditions of cultivation on plantations abroad; and as the result of the visits of their own experts, and of the reports received from many practical agriculturists in different countries, they have elaborated a very wide range of efficient and powerful ploughs, cultivators, harrows, stubble breakers, etc. for animal and tractor draught for use on every kind of soil. These are depicted in this well-compiled booklet, which, in addition to the various types of apparatus, also reproduces photographs of ploughs in operation on sugar estates in Demerara, Natal, India, and elsewhere, which clearly show the nature of the work accomplished. So far back as 1854, it was recorded that the celebrated "Y. C. P. W." plough of this firm was in general use in the West Indies, Cape of Good Hope, and the United States; and authorities state that for cultivation on sugar estates this implement (now incorporating several improvements) remains unrivalled for general purposes. Among other of the specialities of Messrs. Ransomes, Sims & Jefferies, Ltd., which have acquired a similarly high reputation, are their "Defiance" and "Key-Conqueror" disc ploughs; their "President" and "R. S. L D. X." self-lift tractor ploughs; their "Dauntless" tractor cultivator; and their "King" disc harrow. This booklet describes and illustrates these various types and others, giving also general information regarding their advantages and use. It is a publication that should be on file in the office of every tropical agriculturist.

Refractometers. (Bellingham & Stanley, Ltd., 71, Hornsey Rise, London, N. 19.) 1922. Obtainable on application.

As is well known to our readers, the refractometer is capable of furnishing in a few minutes with a high degree of accuracy the water content of a juice, syrup, massecuite, molasses or other sugar factory or refinery product; and there are many who hold that this instrument is as indispensable in the laboratory as a polariscope. In this interesting booklet, Messrs. Bellingham & Stanley, Ltd., describe and illustrate the various types of refractometers made by them. Their standard type is well known, and is largely used as a most suitable instrument for the examination of a variety of materials, as sugar solutions, jams, oils and fats, etc.; in this type several important improvements, particularly in regard to the illumination, the motion of the reader-arm, the opening and closing of the prism box, and the arrangement of the mirror, have been incorporated. This firm makes a second type of instrument at a very moderate price for the examination of sugars and other solutions, capable of giving the index to one unit in the fourth decimal place; and the attention of sugar chemists is particularly called to this design. Another speciality is an immersion refractometer for use with solutions having indices between 1·325 and 1·367; while it is of interest to note that these makers have now designed a high accuracy critical refractometer on the lines stated by Mr. J. Guild, of the National Physical Laboratory.[1]

Chemical Engineering Catalog. Seventh Edition. (The Chemical Catalog Co., 1, Madison Ave., New York, U.S.A.) 1922.

We again draw attention to this useful publication.[2] It consists mainly of condensed illustrated catalogue data of manufacturers in the United States catering in any way for the chemical industries, and in fact consists of a "room full of individual catalogs, indexed, and assembled within the covers of a single book." It is a volume that should be in the hands of the technical chemist and engineer if only for the succinct descriptions and clear illustrations of the types of plant now used in the principal industries with which they may be connected; and by many others it will be found highly serviceable as a well-indexed list of suppliers of the machinery and raw materials used in the arts and manufactures employing chemical processes for some purpose or another.

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[1] See a paper read before the Physical Society of London, March, 1918.

[2] See also *I.S.J.*, 1921, 288,640.

Review of Current Technical Literature.[1]

PRECIPITATE FORMING IN EVAPORATOR SYRUP AFTER CLARIFICATION (USING SULPHITATION, DECOLORIZING CARBON, ETC.) (1) *Victor Birckner. La. Planter, 1922, 68, No. 18, 285-286.* (2 *J. F. Brewster and W. G. Raines, Jr. Journal of Industrial and Engineering Chemistry, 1922, 14, No. 10, 946-947.*

(1) Zerban's method of clarification[2] was tried out during the 1920 season in several factories in Louisiana; but one of the unexpected difficulties encountered was the appearance in the syrup obtained after the evaporation of the juice so treated of a greyish coloured gelatinous precipitate. This insoluble matter was thrown out of solution to a certain extent in the multiple effects, but on heating the syrup at 30° Bé. to boiling point a further amount appeared. As it seemed of much interest to determine its nature, a portion was washed in a centrifuge till free from sugar, incinerated and analysed, the following figures being obtained:—Silica, 35·6; phosphoric acid, 21·7; sulphuric acid, 3·2; calcium oxide, 10·0; ferric oxide, 4·1; zinc oxide, 6·7; manganese oxide, 0·6; and undetermined (including copper and carbon dioxide), 18·1 per cent. A similar precipitation is known to occur in the case of juices clarified with lime and sulphurous or phosphoric acid, calcium sulphate and phosphate being present; but it would seem in this instance of treatment with kieselguhr and decolorizing carbon that the formation of the precipitate must be attributed to factors inherent in the juice itself. Support in favour of this view was obtained by extracting both the kieselguhr and the decolorizing carbon with an artificial cane juice consisting of a slightly acid 10 per cent. solution of sucrose; but in both cases the amount of mineral matter taken up was very small, and consisted of about 60 mgrms. of silica and a trace of iron from the kieselguhr, and of about 80 mgrms. alkali carbonates and small proportions of silica and iron oxide from the decolorizing carbon per 10 grms. of sample examined. Hence, from these results it does not seem probable that the formation of the inorganic portion of the syrup precipitate is attributable primarily to substances dissolved from either of the products used for clarification. PRINSEN GEERLIGS has reported an analysis of a syrup precipitate from juice clarified with lime alone,[3] in which the constituents and their proportions agree fairly well with the author's figures stated above. Some of the added lime had evidently been carried down in the form of calcium organic acid salts; but nevertheless the author's conclusion from his experiments is that in clarification with kieselguhr and decolorizing carbon the formation of the precipitate described is not due to these two materials, but would appear to be attributable mainly to "factors inherent in the juice itself."

(2) Turning to the second paper, these writers also study the nature of the syrup precipitate and its formation, and recall the work by COATES and SLATER[4] who concluded that, although the precipitate is made up of substances insoluble in the ordinary sense, it is held in colloidal solution by the heavy syrup, from which it flocculates on standing. Precipitation invariably occurs to a greater or less extent in syrup from cane, no matter how brilliant the clarified juice may appear before evaporation, and it is impossible to obtain high-grade white sugar unless this insoluble matter is removed by subsiding or preferably by filtration. This therefore being a matter of importance, some small-scale experiments imitating factory conditions as closely as possible were instituted. Juice in 10-litre lots were clarified by six different methods, viz.: (1) use of sulphur dioxide and lime; (2) addition of paper pulp; (3) addition of "Norit"; (4) addition of calcium carbonate (as suggested by Mr. SAUER[5]); (5) liming to neutrality, followed by 0·5 per cent. of "Filter-cel"; and (6) liming to neutrality with no further addition, these six juices being evaporated to syrup, and the precipitate forming collected, incinerated, and analysed. Here are the results:

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*

[2] Treatment of the juice with 1 per cent. of kieselguhr, filtration through plate and frame presses, addition of about 1 per cent. of vegetable decolorizing carbon, and a second filtration previous to concentration in the multiple effect. See *I.S.J.*, 1920, 332, 643, 699.

[3] "Cane Sugar and its Manufacture," page 211. (NORMAN RODGER, Publisher, London.)

[4] *I.S.J.*, 1916, 573. [5] U.K. Patent, 183,485.

	Ash,	ANALYSIS OF ASH, PER CENT.					
	per cent.	SiO_2	Ammonia Ppt.	CaO.	MgO.	SO_3	P_2O_5
1	87·32	23·23	1·11	32·02	None	42·00	0·46
2	63·46	9·99	4·13	38·21	None	34·09	0·73
3	—	26·12	35·97	14·94	1·92	1·67	12·71
4	—	53·58	0·24	40·57	None	6·67	3·34
5	48·28	37·95	25·47	26·35	None	1·63	None
6	64·48	60·82	8·10	—	—	—	—

It is to be noted that the juice used in the first three experiments originated from cane which had not been washed, a considerable amount of adhering soil in consequence passing into the liquid treated; while on the other hand in the remaining tests the juice was derived from cane from which the mud and earth had been thoroughly removed. This seems very significant, since in the above analyses the outstanding feature would appear to be the differences in the ash of the juice from unwashed and from washed cane. Washing cane before crushing is practised at many Louisiana factories; and RAYNER has reported[1] that at one of these the volume of filter-press mud had been reduced by about 25 per cent. (and sometimes by as much as 40 per cent.) in consequence of this procedure. There can be little doubt in view of these results that the presence of adherent soil upon cane would have a great influence upon the quantity of syrup precipitate formed. This is not surprising when it is considered that soil may contain much matter, both organic and inorganic, in the colloidal state which could readily escape removal by our present clarification methods, even including those in which highly adsorbent carbons are employed. It is evident that the formation of precipitate may be attributed to three possible sources, namely, from (*a*) materials used in clarification; (*b*) from substances present in cane juice itself; and (*c*) finally from soil adhering to the cane at the time of crushing. It is added that when treatment with decolorizing carbon is performed at the syrup stage, a precipitate is to be found in the product obtained, and the precipitate analysed by the authors last year[2] resulted from such treatment. There is the possibility, of course, that to some extent precipitate-forming substances may be derived in the colloidal state from the so-called inert filtering media. With regard to settling as the most feasible means of dealing with syrup precipitates, it is remarked that it becomes obvious that two conditions are to be sought, viz., rapidity of settling and compactness of sediment. This suggests that the addition to the syrup, after it has been run to the settling tanks, of some adsorbent heavy enough to quickly subside and carry suspended matter with it, might answer the purpose. Fuller's earth, precipitated chalk, and calcium phosphate are substances the authors have found to show promise in this connexion.

"MOLASS-CHAR" GRANULAR DECOLORIZING CARBON. *M. Weinrich. Facts about Sugar, 1922, 15, No. 7, 132-133.*

Shortly before his death, the late author drew up a statement relating to the advantages and cost of manufacture of his "Molass-char" granular decolorizing carbon, for the protection of which he had taken out patents in various countries.[3] Ordinary amorphous decolorizing carbons, he held,[4] are difficult to filter, and likewise difficult to revivify, owing to their fine state of division; and he believed that it would be very advantageous to combine the active carbon with some mineral bodies, so as to obtain a granular material, that is an artificial char, capable of being used in cisterns and revivified in kilns in the same way as real boneblack. Thus, he claimed to be able to produce from waste molasses, limestone and clay a granular char as hard as boneblack at the following cost in Cuba, P. R., T. H., or Java: 100 tons of blackstrap at $3, $300; 60 tons of limestone at $3, $180; 150 tons of clay at $5, $750; and working expenses, say $600; a total of $1830, from which is deducted $250 the value of the gaseous and liquid by-products, leaving $1580, the yield being 220 tons, so that the cost per ton would be $7·2, which certainly appears moderate. He also claimed to be able to make from the same ingredients a fine "acid proof" char for use in plantation white sugar factories, from which the calcium carbonate had been removed by leaching out with hydrochloric acid, the cost of this being only $16·10 per ton; and lastly a nearly pure carbon from molasses and limestone (but no clay), the lime being also removed by HCl, and the cost $60·05 per ton. Mr. WEINRICH stated that experiments made with his chars at the Louisiana Sugar Experiment Station, and in refineries and factories, had shown their decolorizing power to be greater than that of ordinary bonechar.[1]

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[1] *I.S.J.*, 1919, 524. [2] *I.S.J.*, 1921, 699. [3] *I.S.J.*, 1919, 625. [4] *I.S.J.*, 1921, 167, 524.

DOUBLE CARBONATATION, AND ITS APPLICATION IN SOUTH AFRICA. *Henry M. Pezzani.* *Journal des Fabricants de Sucre, 1922, 63, No. 37, 8.*

This writer's ideas on the subject may be seen from the following extracts: "Considering the somewhat striking analogy that exists between the composition of the Uba cane juice and beetroot sugar juice, especially so far as the low glucosic quotient is concerned, it struck me that a defecation process which was good for this latter might equally be good for the former. But this is of course merely a suggestion, and repeated laboratory tests would have first to be made before attempting the application of the process on an industrial scale. . . . . . With the Uba juice coming as it does from a hard fibrous cane which has to be submitted to great pressure and to abundant maceration at the mills, heavy liming ought to be the rule to remove the wax of which there is a fairly high percentage on the rind of the cane, and also the gummy and albuminoid substances and particles of fibrous matter, all impurities introduced into the juice by the high pressure and maceration just mentioned . . . . As already pointed out above, there is a somewhat close analogy between Uba juice and beetroot juice, the glucosic quotient in the former is sometimes very low indeed and in such cases it is found extremely difficult to exhaust the final molasses to anything like the point reached in Java, Hawaii or Mauritius. The writer remembers having come across finals in Natal with a purity as high as 52° and 53°, and the average for a full season of nine months was as high as 48°. The recent brilliant research work carried out by a Belgian chemist in connexion with the baryta process to remove the sugar left in the final molasses,[2] in the course of which he discovered a cheap method of revivification of the expensive baryta so as to make one cycle of the whole process, bids fair to revolutionize the sugar industry, both the beetroot and the cane, and to solve a chemical problem which so far had sorely taxed the ingenuity of all sugar chemists. To sum up what has been said above, it thus appears that in cane sugar countries where cheap lime and coke, both of good quality, can be obtained in sufficiently large quantities to supply a lime-kiln which, by the way, has to be run continuously like a blast furnace during the whole sugar campaign to give the necessary amount of lime and carbonic acid needed, double-carbonatation can prove to be probably the best defecation method. A wider application of this process to the Natal sugar industry, provided its cost is not prohibitive, is all the more likely to be an improvement on present methods used, if one bears in mind the fact that the Uba juice of South Africa is, by its composition and nature, half way between beetroot juice and the cane-sugar juice found in the other great tropical sugar producing countries."

THE DODEN CANE PLANTER. *Anon.* *Sugar News, 1922, 3, No. 7, 324-326.*

HANS DODEN, a prominent planter of Mindoro, Philippine Islands, claims to have perfected a cane planter, and trials which have been made with it are stated to have elicited expressions of approval from those present. In particular, the following features were demonstrated: (*1*) the cane point is planted in the fresh furrow without the soil in the furrow having a chance to dry up; (2) the seed is covered immediately after being placed in the furrow; and (3) the soil is packed down over the seed preventing the field from drying too rapidly during dry weather. It consists of a box or hopper, into which the seed to be planted is piled; and two double mould-board ploughs which are attached to the frame of the machine so as to furrow to the desired depth. From the hopper to the back of the mould-board ploughs run two flumes into which the seed is dropped. Immediately behind each plough is a device which keeps the side of the furrow from sliding into the bottom of the furrow until after the seed is in place. Behind this protector is a device which covers the seed, and this is followed by a large wheel which packs the soil as the machine moves along. Depending upon the depth to which the plough furrows, the size of tractor required to pull this machine, making two furrows at a time, will vary between 15 H.P. and 30 H.P. Mr. E. W. KOPKE, who witnessed the trials, says that he was pretty well acquainted with other efforts in this direction and considered this machine far superior to any other, being thoroughly practical and simple in appearance. He stated that the average cost of all operations involved in hand planting has been $79·15 per hectare, whereas the Doden planter does this work at a cost of $18·75 per hectare, effecting a saving of $60·40 per hectare. Further, with the machine there is substantial saving of seed. Mr. Doden's figures show only 37 per cent. as much seed used by the machine as is used in hand-planting over similar areas, and the machine-planted stands are much the better. The machine eliminates a loss which has occurred in hand-planting, i.e., it gets the cane into the ground while the roots, started by soaking the cuttings, are fresh and vigorous. In hand-planting there is frequently delay at this critical period; and often the benefit of sprouting the cane in water is lost entirely. Arrangements are now being made for the manufacture of these planters in quantities so that they can be distributed to farmers in the Philippine Islands in time for the next planting season.

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[1] Many attempts have been made to produce a cheap granular artificial char having a much higher decolorizing power than boneblack, the advantage being economy in the cost of the material and in that of the fuel for washing water and revivification. In such a material, the grains would require to be at least as hard and porous as those of animal charcoal, and capable also of "holding up" in revivification. It would seem therefore that the late inventor was working in the right direction; and those who are interested in his material should write for samples and particulars regarding the disposal of his patent rights to his widow: Mrs. MORIZ WEINRICH, 99, Claremont Avenue, New York, U.S.A.—EDITORS, *I.S.J.*

[2] Presumably an allusion to Deguide's invention. See *I.S.J.*, 1922, 494.

DETERMINATION OF THE *p*H VALUE OF COMMERCIAL GLUCOSE AS A SUBSTITUTE FOR THE "CANDY TEST." *Otto A. Sjostrom. Journal of Industrial and Engineering Chemistry, 1922, 14, No. 10, 941-943*

Generally the acidity of commercial glucose is low, about 0·01 per cent. (as HCl), using phenolphthalein, but it has long been known that titration is not a correct index of the suitability of glucose for the confectionery manufacturer, so that what is called the "candy test" has to be made. Glucose, cane sugar, and water are heated in a copper pan[1] at such a rate that the temperature reaches 320°F. (160°C.) in 25 min., the amount of invert sugar formed in the mixture as the result of this treatment being determined. It should not amount to more than 8·5 per cent. A more rapid procedure for controlling the acidity, and one at least as trustworthy, exists in the determination of the H-ion or pH value. This has been applied to a good number of samples (diluted to 22°Bé.) using the colorimetric method with methyl red as indicator, comparing these results with those of the candy test. Comparison of the two sets of figures obtained shows the candy test to be far from reliable, unless particular care be taken in regard to the observance of details of temperature and time, though when these conditions are fulfilled variation in the amount of invert sugar produced and the pH value of the glucose sample corresponded fairly well. An invert sugar formation of 8·5 per cent. corresponds to a pH value between 4·1 and 4·2; but one of 4·3 is considered as the upper limit of acidity for factory control purposes. Generally in manufacture the pH value of the batches runs between 4·5 and 4·9 (corresponding to an invert formation of 4·8 to 6·4 per cent. in the candy test.)

CRYSTALLINE GLUCOSE-AMMONIA AND ISO-GLUCOSAMINE. *Arthur R. Ling and D. R. Nanji. Journal of the Chemical Society (Transactions), 1922, Nos. 719, 1682-1688.*

J. P. O.

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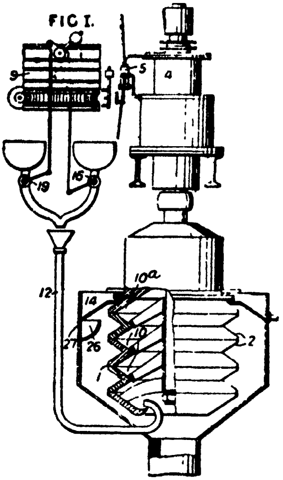
[1] The proportions of these ingredients are not stated.

Review of Recent Patents.[1]

UNITED KINGDOM.

CENTRIFUGAL SEPARATOR. *Wilhelm Mauss,* of Johannesburg, British South Africa. *182,856.* March 8th, 1921.

FIG I.



Liquids are decanted from solids in a centrifugal drum rotating at a constant speed and the separated solids are washed and samples are taken from the settlement chamber. In his previous application[2] the inventor showed an additional receiver into which the contents of the last chamber *10a* were discharged, separately from the contents of the chambers *10*. Provision was made for inspecting such material and either returning the same for retreatment or adding it to the discharge from the chambers *10* if it were sufficiently separated. According to the present invention, after the supply of unseparated material to the decanter is stopped, the contents of the chambers *10* and *10a* are washed to displace the original liquid still remaining with the solid. The whole contents of the drum are then discharged, and provision is made for taking a sample of the discharge from the last chamber *10a*. The apparatus is controlled by a revolving drum *9* with a number of tappets which actuate the necessary valves. When the machine is working, the valve *16* is opened so that the mixture is supplied through the pipe *12* to the separating drum *1* and the solids are packed mainly in the lower chambers *10* of the drum while the clean liquid is passed into the receiver *14*. The valve *16* is then closed and the valve *19* opened to admit the washing-water. During the washing the valve *5* of the motor *4* is opened and the motor opens the drum *1* to discharge the solid matter. The valve *19* is then closed and immediately afterwards the valve *5* is closed to stop the motor *4*. A pocket *26* on the inside of the casing door *27* intercepts a part of the discharge from the drum chamber *10a*. If too little solid matter is found in it, the tappets are set to prolong the separation period.

EVAPORATOR, USING THERMO-COMPRESSION. *Metallbank and Metallurgische Gesellschaft A.-G.,* of Frankfurt am. Maine, Germany. *181,482.* March 14th, 1921.

This invention consists of a method for obtaining maximum economy with a steam-driven turbo-blower by leading the exhaust steam of the compressor engine back into the suction side of the compressor conveying the vapours. By this arrangement, on the one hand, the radiant heat loss of the system is completely compensated by the heat of the exhaust steam so that the special introduction of heat otherwise required can be dispensed with, and, in addition, the greater part of the exhaust from the driving engine can be utilized as heating steam for the evaporator. A special advantage obtains when the plant is run as a vacuum evaporator. In this case a heat drop to the vacuum of the evaporating system is available for the utilization of the working steam in the driving engine. The exhaust steam from the driving engine leaves the same under a vacuum without a special condenser being needed for the condensation of this exhaust steam.

DISCHARGER FOR SUGAR CENTRIFUGAL MACHINES.[3] *E. Daniels, G. McKinlay, and E. Kopke,* of Honolulu, T.H. *183,028.* June 23rd, 1921.

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[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2fr. 00 each).

[2] U. K. Patent, 164,418; *I.S.J.*, 1921, 592.

[3] U.S.P., 1,388,173; *I.S.J.*, 1922, 50.

Rotary Knives for the Preparation of Cane previous to Milling. *Cornelis J. H. Penning*, of Manila, P.I. *182,835*. January 19th, 1921.

A rotary cutting and levelling device is provided, in which a plurality of slotted or recessed knives are fitted directly on a shaft or other rotary member adapted to support them. Each knife is secured on the shaft or member by devices which engage the shaft on one side and are extended to clamp the knife on the other side of the shaft or member and each knife cannot rotate in relation to the said shaft or member, but can be detached from and adjusted around and/or along the latter independently of the other knife or knives. Turning to the illustration, it will be seen that in order to secure such knife *b* to the rotary shaft *e* so that they may be readily attached or adjusted, each double-ended blade knife *b* is formed with a slot *d* extending from the side to a central hole *c* adapted to engage the shaft *e*. Part of the shaft is of square, hexagonal, octagonal, or other shape to give flats *h*, grooves *i* being cut through these flats to receive the knives which preferably are a jam fit in the grooves. The shaft at the bottom of the grooves may be of circular, square, hexagonal, octagonal, or other shape, the holes in the blades corresponding thereto. A saddle-piece *j* fits over the slotted side of each knife and engages the flats on the shaft, being clamped there against by bolts *k* having hooked ends *n* which engage the far side of the knife. A distance-piece *p* may be fitted in the slot of each knife. The knives may be made of case hardened mild-steel or of boiler plate provided with tool-steel cutting edges. In a modification, U-shaped bolts passing over one edge of the knife on each side of the shaft pass through bars extending across the side of the shaft remote from the knife-edge engaged by the bolts. These U-shaped bolts may be replaced by straight bolts passing through bridge-pieces extending over the edge of the knife.

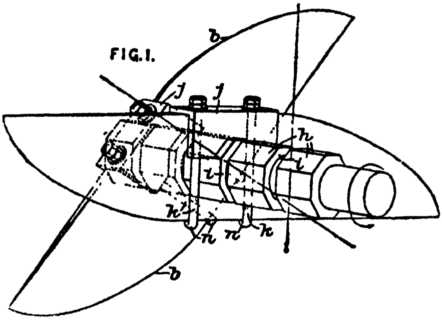

FIG. 1.

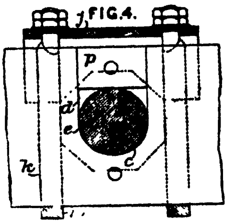

FIG. 4.

Distillation of Alcohol in Column Stills. *Joseph Schneible*, of Chicago, Ill., U.S.A. *182,832*. January 13th, 1921.

Claim 1.—A process for the distillation of alcohol and other liquids in a column still, comprising a heater surmounted by cooled and uncooled dephlegmating plates, characterized by controlling the heat supply to the heater to produce a constant temperature in the column above the heater, and controlling the supply of cooling medium to the cooled plates to produce a constant temperature at a fixed point in the column, whereby a uniform temperature gradient through the column is produced, and maintaining the interior of the still free from accumulations of refuse liquid above the heater.[1]

Motor Fuel containing Alcohol. *J. D. Riedel A. G.*, of Britz, Berlin. *184,785*. July 6th, 1922; convention date, August 15th, 1922.

It consists of a mixture of a hydro-naphthalene, an aliphatic hydrocarbon of low boiling point, and methylated spirit, blended by a small proportion of ether or an alcohol of high boiling point. In an example, 30 parts of tetrahydro-naphthalene, 35 of petrol or light petroleum, and 30 of methylated spirits are blended by the addition of 5 parts of amyl alcohol.

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[1] See also *I.S.J.*, 1922, 498, 500.

MOTOR FUEL CONTAINING ALCOHOL. *H. R. Ricardo*, of Pall Mall, London. *183,577.* April 26th, 1921.

A fuel for internal-combustion engines comprises a solution of water in benzol and acetone. Ethyl or methyl alcohol and ether may be added. The water should comprise 8·16 per cent. of the liquid. The preferred composition consists of 60 lbs. of ethyl alcohol, 20 lbs. of acetone, 10 lbs. of benzol or benzene, and 10 lbs. of water.

MOTOR FUEL CONTAINING ALCOHOL. *J. Hawes*, of Johannesburg, South Africa. *184,607.* May 27th, 1921.

Alcoholic fuel is denatured by not more than 5 per cent. of nitrobenzene. A suitable composition consists of 96 vols. of 96-98 per cent. ethyl alcohol, two of petroleum naphtha, one of nitrobenzene, and one of amyl alcohol. (In the provisional specification, petroleum naphtha was omitted).

MANUFACTURE OF 98-99 PER CENT. ALCOHOL. *J. Van Ruymbeke*, of Marseilles, France. (1) *184,036.* July 15th, 1921. (2) *184,129* (addition to 184,036). March 22nd, 1922.

(1) By distillation alone, alcohol stronger than 97·2 per cent. by volume cannot be prepared; but in this specification a method of making spirit having a concentration of 98-99 per cent. is described, this being done by bringing the vapours into contact with glycerine which acts as a dehydrating agent. Strong alcohol vapour passes to the base of a column down which glycerine is flowing, the vapour thus dehydrated going to condensers, while the glycerine is treated for the separation of water it has taken up, in order that it may be used again. (2) In dehydrating alcohol by the procedure just described, instead of pure glycerine, a solution in glycerine of an anhydrous or hygroscopic salt, such as calcium chloride, zinc chloride, or potassium carbonate, is used as the dehydrating agent.

PACKETING OF SUGAR IN CARTONS. *Soc. Anon. Raffinerie Tirlemontoise*, of Tirlemont, Belgium. (1) *161,567.* March 15th, 1921. (2) *184,103*, (addition to 161,567). November 2nd, 1921.

CONCENTRATION OR DISTILLATION OF SUGAR SOLUTIONS OR FERMENTED LIQUIDS. *C. H. Casper*, of Philadelphia, U.S.A. *184,760.* October 18th, 1921; convention date, August 17th, 1921.

In concentrating or distilling liquids, such as sugar solutions, fermented products, fruit-juices, etc., a gaseous medium (as air or carbon dioxide) in maintained in continuous circulation over the liquid and through a condenser, heating being carried on at atmospheric or higher pressures.

SELF-BALANCING CENTRIFUGAL BASKET. *William McChesney*, of Ealing, London. *184,952.* June 29th, 1921. (One drawing; five claims.)

In suspended centrifugals as hitherto used, it frequently happens that, owing to the practical impossibility of ensuring that the centre of gravity of the loaded basket lies in the longitudinal axis, the basket during revolution acquires a "wobbling" motion varying with the degree of want of balance, which wobbling motion has the serious disadvantage that the basket tends to rise and reduce the controlling effect of the supporting buffer. In order to obviate this defect, the basket is provided with a mounting which prevents undue wobbling on starting with the least resistance to the basket taking up a position of balance when revolving with an unevenly distributed load. For this purpose, the basket is mounted on one end of a non-revolving column or sleeve, so that the basket is capable of a certain amount of tilting motion on the column, controlled by a suitable non-revolving elastic buffer or buffers. The other end of the column or sleeve is entirely supported by an elastic buffer or buffers, for example, on a tapered buffer which allows the basket to swing lightly about a centre situated approximately at the lower end of the supporting column or sleeve.

FRANCE.

MANUFACTURE OF DIRECT CONSUMPTION SUGAR WITHOUT THE PRODUCTION OF MOLASSES FROM THE BEET, CANE, SORGHUM, ETC. *Puvrez, Goffin & Cie, and Joachim Weisberg.* *529,240.* July 30th, 1920.

After thoroughly clarifying the juice (applying Weisberg's sulphi-carbonatation process,[1] for example) it is evaporated, boiled, and grained in the usual manner, and the massecuite stiffened to a water content of about 4 per cent. At this point the vacuum is broken, and the temperature made to rise to a degree somewhat above 100°C., say to 105°C. (221°F.), then the massecuite is dropped into moulds, which are rapidly cooled to 20°C. This superheating operation has as its effect the decomposition of the non-sugars uneliminated during the operation of clarification; and it is said that in this way, in the case of beet juice, the unpleasant flavour is destroyed. The sugar in the moulds (which therefore contain all the sucrose originally present in the root, excepting that lost in the process of manufacture) is broken or pulverized, and sold as a direct consumption product.

UTILIZATION OF THE WASTE WATERS FROM THE PULP PRESSES OF THE BEET FACTORY FOR THE PRODUCTION OF A FODDER. *Adrien L. Leduc.* *528,632.* December 19th, 1919.

They are concentrated to the state of syrup, which is mixed with chopped straw, scums, or similar material to form a suitable cattle food or fertilizer, using a multiple effect evaporator fed with high-pressure steam from which vapour is taken for the usual purposes of the factory, viz., heating and concentration of the juice.

GERMANY.

RECOVERY OF THE SUGAR FROM THE WASTE WATERS FROM THE PULP PRESSES AND DIFFUSION BATTERY OF THE BEET FACTORY. *Herman J. N. H. Kessener and Nicolaas L. Söhngen,* of the Hague, Holland. *345,551.* December 13th, 1921.

In order to clarify the waste waters from the pulp presses and diffusion battery of the beet factory, they are clarified by the addition of the carbonatation scums. It is pointed out in the specification that this procedure is not new, but that no useful effect has resulted because the amount of scums hitherto employed has been insufficient, so that on returning these waste waters to the battery for the purpose of effecting extraction there, trouble was caused by the presence of the fine particles of beet pulp still remaining. Claim is therefore for the addition of at least a quarter of the carbonatation scums produced in every factory for the purpose under consideration, the result being after subsiding and filtering that a clear alkaline liquid suitable for use in the diffusion battery is obtained. In a beet factory slicing daily 2½ million kg. of roots the amount of diffusion and pump-press waste waters is 3500 cub. m. (that is 140 per cent. of the weight of beets, being 110 per cent. of diffusion waste waters and 30 per cent. of pulp-press waters); while the amount of carbonatation scums is 10½ per cent. of the weight of the roots, i.e., 250,000 kg.

PROCESS FOR THE PRODUCTION OF CONSUMPTION SUGAR WITHOUT OBTAINING MOLASSES. *Adolf A. Holland,* of Wedel, Holstein. (1) *348,064.* June 20th, 1918. (2) *351,376,* addition to the previous patent. September 27th, 1918.

(1) Raw sugar is affined, and the run-offs, after they have been filtered and treated for the elimination of their salts, are directly dried to a fine powder by means of heated air, a consumption sugar thus being obtained without the production of molasses, and without carrying out the repeated boilings customary in the usual mode of refining. (2) In this addition claim is made for the process of refining raw sugar in which the

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[1] French Patent, 455,936; *I.S.J.*, 1914, 440.

affined crystals are dissolved in water, and the liquor after it has been filtered, dried to a fine powder by means of heated air. Thus, it is stated, a consumption sugar of good quality may be produced.

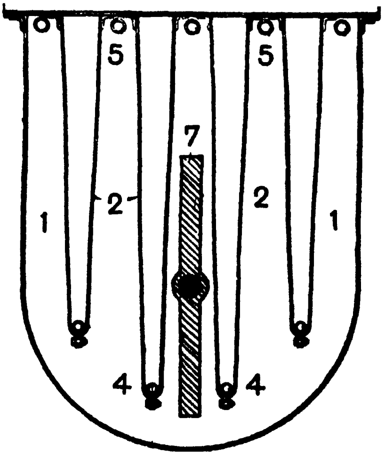
PRODUCTION OF DECOLORIZING CARBON. *W. Eberlein,* of Ahrensburg, Holstein, Germany. *307,053.* January 26th, 1922.

If alkaline extracts of peat, brown coal, or the like are mixed with a non-carbonaceous material in a fine state of sub-division, and ignited with exclusion of air, a decolorizing material of high activity is obtained. In an example, brown coal is treated with soda, the solution mixed with three to ten times its amount of alumina, and the mixture ignited in the absence of air, the carbonized mass being purified with water and acid and dried. In another example, the alkaline solution obtained from peat or brown coal is mixed with five to ten times its amount of common salt, finely ground, and incinerated with exclusion of air, the salt being finally removed by washing.

HOLLAND.

APPARATUS FOR THE AFTER CRYSTALLIZATION OF MASSECUITES. *Paulus E. Botje,* of Kadipaten, Cheribon, Java. *5315.* October 1st, 1920.

It consists of an open tank *1* (holding about 100 h.l. of massecuite), in which is placed a number of small, suspended removable, cooling-boxes *2*, made of sheet iron, which are placed lengthways alongside one another, which are narrowed at their extremity, and which are connected with pipes *4* carrying a heating or cooling medium, e.g., air. At the top part of the tank in the space between the cooling-boxes are perforated iron pipes *5* through which syrup may be introduced into the tank when necessary. Further, a stirring gear *7* is provided. In operating the apparatus, the cooling-boxes *2* are placed in the tank *1*, and the cooling-boxes as well as the tank itself are closed with suitable sheet-iron covers. Hot air is passed by means of a fan through the pipes *4* so as to impart to the whole tank the temperature of the massecuite under treatment. After keeping the massecuite in the tank for some hours, the covers are removed, and some hours later the temperature of the air is reduced, while some hours still later unheated air is used. When the temperature has fallen to 45°C., then the cooling-boxes *2* are lifted out of the tank *1*, syrup being added if necessary, and the stirring gear *7* put into motion. After one hour's mixing the massecuite is ready for curing. The whole operation from the filling of the tank to the curing of the massecuite can be carried out within 24 hours; heating and cooling are entirely under control, and the result is that crystallization can be accomplished more rapidly and more completely than in systems which are not provided with the arrangements described; while, moreover, the formation of false grain is avoided, a matter of importance for easy curing and also for obtaining a high rendement. The apparatus is pre-eminently suited for the after-crystallization of muscovado and "syrup sugar" massecuites, which after cooling in this tank do not stiffen to such an extent that mixing is very difficult. Reference is made to German patent 229,871 which describes a somewhat similar apparatus for cooling brine solutions, but mainly differs from the present invention in not being provided with the stirring gear mentioned.



Sugar Crops of the World.

(Willett & Gray's Estimates of Crops to October 26th, 1922.)

	Harvesting Period.	1922-23. Tons.	1921-22. Tons.	1920-21. Tons.
United States—Louisiana	Oct.-Jan.	215,000	289,669	150,996
Texas	,, ,,	1,000	2,920	6,238
Porto Rico	Jan.-June	400,000	385,000	438,494
Hawaiian Islands	Nov.-July	490,000	490,000	508,392
West Indies—Virgin Islands	Jan.-June	6,000	5,000	4,500
Cuba	Dec.-June	4,000,000	3,996,387	3,936,040
British West Indies—Trinidad	Jan -June	55,000	52,000	54,933
Barbados	,, ,,	35,000	36,000	24,817
Jamaica	,, ,,	38,000	42,167	39,960
Antigua	Feb.-July	12,000	9,850	11,320
St. Kitts	Feb.-Aug.	15,000	8,426	8,063
Other British West Indies	Jan.-June	10,000	9,238	3,603
French West Indies—Martinique	Jan.-July	19,700	18,329	23,834
Guadeloupe	,, ,,	30,000	32,000	25,426
San Domingo	Jan.-June	200,000	225,000	185,546
Haiti	Dec.-June	12,000	12,283	5,625
Mexico	,, ,,	120,000	119,800	115,000
Central America—Guatemala	Jan.-June	20,000	19,090	17,500
Other Central America	,, ,,	28,000	27,972	36,692
South America—				
Demerara	Oct.-Dec. and May-June	100,000	108,270	96,168
Surinam	Oct. Jan.	11,000	10,000	9,394
Venezuela	Oct.-June	16,000	16,000	15,000
Ecuador	Oct.-Feb.	8,000	7,000	6,998
Peru	Jan.-Dec.	340,000	325,000	344,024
Argentina	May-Nov.	200,000	175,000	202,158
Brazil	Oct.-Feb.	340,000	325,000	340,063
Total in America		6,721,700	6,747,401	6,610,784
Asia—Brit. India (consumed locally)	Dec.-May	2,475,000	2,500,000	2,506,320
Java	May-Nov.	1,658,000	1,649,610	1,508,755
Formosa and Japan	Nov.-June	405,800	406,966	342,176
Philippine Islands	,, ,,	290,000	276,000	255,843
Total in Asia		4,828,800	4,832,576	4,613,094
Australia	June-Nov.	300,000	298,701	182,401
Fiji Islands	,, ,,	52,000	65,000	73,000
Total in Australia and Polynesia		352,000	363,701	255,401
Africa—Egypt	Jan.-June	90,000	100,000	79,706
Mauritius	Aug.-Jan	225,000	182,234	259,872
Réunion	,, ,,	40,000	38,593	42,079
Natal	May-Oct.	140,000	161,000	151,500
Mozambique	,, ,,	45,000	35,000	51,009
Total in Africa		540,000	516,827	584,166
Europe—Spain	Dec.-June	6,000	5,000	6,886
Total cane sugar crops		12,448,500	12,465,505	12,070,331
Europe—Beet sugar crops		4,710,500	4,066,042	3,671,788
United States—Beet sugar crop	July-Jan.	650,000	911,190	969,419
Canada—Beet sugar crop	Oct.-Dec.	15,000	18,931	34,600
Total beet sugar crops		5,375,500	4,996,163	4,675,807
Grand total Cane and Beet Sugar	Tons	17,824,000	17,461,668	16,746,138
Estimated increase in the world's production	,,	362,332	....	....

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1922. Tons.		1921. Tons.
Total Receipts, January 1st to October 25th..	3,229,104	..	2,178,857
Deliveries ,, ,, ...	3,225,416	..	2,189,409
Meltings by Refiners ,, ,, ...	3,184,313	..	2,157,884
Exports of Refined ,, ,, ...	808,000	..	335,000
Importers' Stocks, October 25th..	3,688	..	—
Total Stocks, October 25th	46,546	..	61,072
	1921.		1920.
Total Consumption for twelve months	4,107,328	..	4,084,672

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1919-1920, 1920-1921, AND 1921-1922.

(Tons of 2,240 lbs.)	1919-20 Tons.		1920-21. Tons		1921-22. Tons.
Exports	3,209,884	..	2,036,417	..	3,430,488
Stocks	311,063	..	1,187,555	..	333,411
	3,520,947		3,223,972		3,763,899
Local Consumption	70,700	..	95,000	..	117,548
Receipts at Ports to September 30th	3,591,647		3,318,972		3,881,447

Havana, September 30th, 1922. J. GUMA. – L. MEJER.

Beet Crops of Europe.

(Willett & Gray's Estimates to October 26th, 1922.)

	Harvesting Period.	1922-23. Tons.	1921-22. Tons.	1920-21. Tons.
Germany	Sept.-Jan...	1,600,000	1,330,000	1,152,960
Czecho-Slovakia	Sept.-Jan...	750,000	659,907	705,919
Hungary and Austria	Sept.-Jan...	69,500	78,822	47,977
France	Sept.-Jan...	560,000	278,273	305,041
Belgium	Sept.-Jan...	300,000	289,866	242,589
Holland..............................	Sept.-Jan...	285,000	376,000	317,196
Russia (Ukraine, Poland, etc.)............	Sept.-Jan...	220,000	49,374	88,490
Poland	Sept.-Jan...	270,000	225,000	189,834
Sweden	Sept.-Jan...	63,000	227,000	164,194
Denmark	Sept.-Jan...	105,000	146,800	134,835
Italy	Sept.-Jan...	260,000	217,500	135,484
Spain................................	Sept.-Jan...	170,000	135,000	170,722
Switzerland	Sept.-Jan...	8,000	5,500	3,710
Bulgaria	Sept.-Jan...	25,000	22,000	7,837
Rumania	Sept.-Jan...	25,000	25,000	5,000
Total in Europe		4,710,500	4,066,042	3,671,788

Sugar Market Report.

Our last report was dated 12th October, 1922.

Since that date, the course of the market has been on the whole of a quiet and uneventful character, and terminal market quotations have maintained, with minor fluctuations, the level then noted. The only feature of interest in that market has been the reflection in the value of October delivery of the shortage of ready and prompt white sugar which caused October to stand at a premium of about 9d. per cwt. over the succeeding months. At this date values are as follows:—November 21s. 3d., December 21s. 1½d., March 21s. 4½d., and May 21s. 7½d.

Whilst the lower descriptions of white sugar have remained practically without change, superior qualities show some appreciation. London Refined, during the period under review, has been advanced by 1s. 6d. for Granulated and 1s. per cwt. for Cubes. Present quotations are:—London Granulated 51s 6d., No. 1 Cubes 57s. duty-paid spot terms.

Owing to the late harvesting of the Beet Crop, and the consequent delay in the working of the roots, Continental sugars for near deliveries have not been offered in any great quantity. Czecho-Slovak sugars have been particularly scarce, and practically the only business passing in these kinds has been the occasional re-sale of small lots. Such marks as SCH, TTD, A, etc., have been sold at from 21s. 6d. to 22s. for Nov./Dec. delivery f.o.b. Hamburg. Good Belgian Granulated, F.W., etc., has been in demand and shows a rise of about 1s. 4½d. per cwt., sales having been effected up to 20s. 9d. for ready parcels f.o.b. Antwerp.

In the continued absence of first-hand offerings of American Granulated, supplies for shipment or afloat have practically disappeared, and this description is now represented only by a small and rapidly diminishing quantity held in store in this country, which has been selling at prices up to 50s. duty-paid. White Java Crystals on duty-paid terms are obtainable at 47s. 9d. to 48s. 6d. according to quality, and afloat for near arrival at 20s. 4½d. c.i.f. Mauritius Crystals on the spot are quoted at 46s. 6d. to 47s. West Indian Crystallized has been in quiet demand at prices from 42s 6d. to 45s. according to quality.

The Cuban Crop 1921/22 is now completed, all Centrals having ceased grinding, although a small quantity has still to arrive at the ports. The final out-turn figure is 3,996,387 tons against 3,936,040 tons in the previous year. Receipts for the past week to 4th November amount to 6,000 tons, Exports 57,000 tons, leaving a stock at the ports of 172,000 as compared with 10,000 tons, 59,000 tons and 1,105,000 tons respectively for the corresponding week of last year. First transactions are reported in New Crop sugars, small quantities of Centrifugals for January/March shipment having been sold at from 3·00 to 3·15 cents per lb. f.o.b. Cuba, and business is reported to have been effected recently to British refiners at 17s. 3d. c i.f. U.K. for January shipment.

The Java market has remained steady—quiet, with little fluctuation in prices. Latest advices report that the market is on the easy side, quotations for White Java Crystals being Nov./Dec. 12½ guilders, Jan./Feb. 12⅞ guilders first cost. A small business is reported for India at 19s. c. & f. Calcutta basis, January shipment. A considerable balance of the present crop remains unsold in the hands of shippers, but there has been no indication of any desire to press this sugar unduly upon the market. Substantial sales of the 1923 crop have already been made by the Trust. It is reported that such sales, up to 31st October last, included:—

White Javas	80,000	tons.
Soft Sugars	11,000	,,
Browns	118,000	,,
Muscovados	152,000	,,
Molasses	2,100	,,
	363,100	tons.

The Indian markets exhibit no sign of a revival of demand. Stocks at the ports at the beginning of November were:—

Bombay	29,800	tons.
Karachi	14,900	,,
Calcutta	26,671	,,

A point to be remembered is that, from 1st January next, the basic year upon which the 25 per cent. *ad valorem* Import Duty is calculated, becomes automatically changed from 1921 to 1922. The effect of this will be a reduction equivalent to about 3s. 3d. per cwt. in the duty. Whether such alteration will have a stimulative effect upon the enquiry from India for Java, etc., sugars, remains to be seen.

News from all quarters with regard to the crops are generally of a favourable character. The new Cuban crop is stated to be making good progress and an early commencement of operations is looked for. The harvesting of Continental beet crops, after an initial delay in some countries, has proceeded normally under generally favourable weather conditions.

10 & 11, Mincing Lane,
London, E.C. 3,
9th November, 1922.

H. H. Hancock & Co.

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

The Conservative Government confirmed in Power.

The result of the elections held in the United Kingdom on November 15th was to confirm in power Mr. Bonar Law's new Government by a larger majority than most of his supporters had anticipated, since he secured for his party a majority of at least 79 over all other parties. There was in the towns (particularly in the Glasgow engineering centres) a big reversion to Labour, and the Labour party secured an increase from 76 members in the last Parliament to a representation of no less than 139. But elsewhere in the county towns and boroughs the Conservative policy triumphed at the expense of both Mr. Lloyd George's National Liberals and Mr. Asquith's Independent Liberals. The last-mentioned party can no longer be accurately labelled the "Wee Frees" inasmuch as they have returned 59 members as compared with the 53 belonging to Mr. Lloyd George's following.

The country was tired of a Coalition that necessitated repeated compromises of policy to secure acquiescence from the two wings; it was also of the opinion that Mr. Lloyd George while more responsible than any other man in this country for winning the war was nevertheless not thereby justified in holding office for ever afterwards; it objected also to the way he had nullified the customary form of Government by Cabinet and had substituted a virtually one-man rule in which he, instead of the proper Departments of State, investigated and decided the various' home and foreign policies of the country; it was tired of experiments in legislation mostly conceived in haste, and wanted a Government that would cry a halt, and take time for reflection while at the same time giving the country its two most urgent needs, a reduction in taxation and a free hand for trade to revive. The country has decided that the Conservatives (who by the way have been out of office since 1905 or for 17 years) shall once more have a chance to govern the country. We trust they will do so wisely and enable British industry to make as speedy as possible a recovery from the wreckage of war.

As far as we are concerned, our chief consideration is what attitude the new Government will take towards the sugar industry. It should not be forgotten that it was the Conservative element in the Coalition Government that was responsible for the enactment of Imperial Preference which has already been confirmed for the next ten years so far as the Government can be answerable for it.

Political speeches during the election revealed the fact that neither the Independent Liberals nor the Labour party would look with a friendly eye on the continuation of this preference. The Liberals are still convinced worshippers of the free trade fetish, while Labour though protectionist at heart (and in practice where trade union rules are concerned) is bent on taking off all food taxes, that of sugar included. But though Mr. BONAR LAW has pledged his party not to introduce for the time being any new measures of tariff reform, he is not bound to cancel what his party have already helped to establish, and it may be taken for granted that Imperial Preference is safe for another five years at least, which means that British produced sugar will continue to enter the United Kingdom at a preferential rate of duty.

This will not however exhaust the Government's intentions towards the Empire, since Mr. BONAR LAW undertook if he was confirmed in power to call together a conference of representatives of the Empire to discuss what could be done to further Imperial trade. While he is evidently precluded from accepting any suggestions to extend Imperial preference by extra tariffs, there are other ways and means, as a writer in the *Times* has lately pointed out: "What is needed is a settled policy in regard to trade, transport and migration, to be followed in co-operation by all. Special transport arrangements might be agreed to and the question of the better distribution of population throughout the Empire should be tackled. "There are in the Empire vast areas practically unpeopled and though this country cannot dictate to the self-governing Dominions what should be their policy, this matter should certainly be the subject of general discussion and agreement."

Congressional Elections in the United States.

While we in the United Kingdom have just had a General Election which has confirmed in power the party that broke up the coalition, the Americans have been having their usual three-year Congressional elections. These have gone badly for the Republicans, whose huge majority has dwindled to 8 in the Senate and 7 in the House of Representatives. Even this bare majority is not absolute, since some of the so-called Republicans elected are known to have leanings towards the other party; so the two years further of Harding administration will prove a time of great difficulty for the President.

There seems little doubt that the country resented the greatly enhanced tariff lately enacted, which is thought to be of only sectional advantage and to be a burden to the community at large. It is true that powers were given the President in the new Law to reduce or raise the tariff if thought fit; and he has appointed an independent Commission to investigate and report on whether any changes or variations are advisable. Possibly now that the States of the Union have given the Republican President such a sharp lesson through the polls, he may think it wise to give the Commission in question all the latitude possible to whittle down the excessive tariff rates imposed under the old Congress. These can hardly be an unmixed blessing for the country though they would certainly favour sundry manufacturing interests. As regards sugar, it has been abundantly shown, we think, that the old emergency tariff was ample to protect the indigenous sugar industry, and we should not be surprised if before long a modification of the new sugar tariff was announced.

But whereas in England, a General Election if decisively won by a given party puts that party in power immediately as a matter of course, in America the defeated party is allowed a further period of rule, apart from the control exercised by the President himself (assuming he belongs as in the present case to the party rebuffed at the polls). Thus the old Congress with its big Republican majority does not go out of office till next March; till then it can be called into session to pass whatever legislation the President thinks it advisable to push through. The new Congress lately elected will not meet before December 1923, unless the President should see fit to call a special session next summer or autumn. So what with deaths and retirements, it seems open to possibility that the above small majorities may be wiped out by a year hence, that is if the United States electors continue to lean towards the Democratic party. In any event, while Great Britain has secured a stable Government for a term of years, the United States seems in for a period of uncertainty and compromise, such as we in this country have just put an end to.

Production and Consumption.

Last month we published Willett & Gray's preliminary estimates of the 1922-23 world's sugar crops. They revealed, as that eminent firm of statisticians themselves remarked, that there is very little change indicated for any of the important sugar crops of the world, particularly those of cane sugar which total practically the same as those of 1921-22. In the Continental United States the output of beet and cane is expected to be some 335,000 long tons less than last year; on the other hand Europe is expected bar accidents to increase the beet sugar output by some 644,000 long tons.

The net result of all the sugar crops is estimated by WILLETT & GRAY as at most an increase of some 362,000 tons. Unfortunately the world is faced by the fact that as compared with last December, the carry-over into 1923 is to be less by the huge amount of one million to one and a half million tons. Given therefore a maintenance only of the 1922 demand for consumption, a shortage will develop during 1923 which is bound to send the price of sugar up still higher. There are, it is true, those who argue that the 1922 consumption is not a true one but is the result of the restocking of invisible supplies which had diminished during the abnormal post-war years, and that therefore 1923 will show a decreased consumption. But there is apparently little or no evidence to support this view, while the contrary is indicated by the fact that the trade distributing channels generally are not too well stocked. More probably is it that the Old World is getting out of the restrictive groove in which the war landed it and is seeking a bigger *per capita* consumption, while the New World, so far as the United States is concerned, has developed a permanently increased demand for sugared drinks to take the place of the prohibited alcoholic beverages.

The result is that in 1923 sugar consumption will have overtaken and passed production; the producer will hence be in receipt of a much more remunerative price for his sugar, which will *inter alia* give him the means to enlarge his output, either by laying down more efficient machinery, or else by increasing his cane crops and milling a larger output of canes. Either way the industry should receive a much needed fillip which we trust will be reflected in a marked increase in orders for sugar machinery, plantation supplies, and factory adjuncts. It cannot be pretended that as a result of the warfare, war restrictions and trade depression of the last ten years the sugar producing industry is in a very efficient condition with regard to its plant and apparatus. A hand-to-mouth policy has been carried on for so long that we think proprietors of sugar factories will welcome the first opportunity of a thorough overhaul, if not modernization, of their plant, and all the indications seem to point to a comparatively early realization of this desideratum.

Completion of the Cuban 1921-22 Crop.

Complete figures of the Cuban sugar crop of 1921-22 now available show that it has exceeded four million tons, the exact figures being 4,033,455 long tons. This is clearly the largest on record, though the 1920-21 figures ran it close but came short of the four-million ton mark. Other figures of the crop just completed are: Cane ground 34,262,932 tons; molasses produced, 203,146,196 gallons; cane burnt, 3,493,028 tons; cane left on field, 2,305,174 tons. The average yield was 11·77 per cent. or 8·49 tons cane per ton of sugar, this high figure being due to the very favourable ripening weather.

Bar accidents, the new crop promises to be at least equal to the one just completed, but heavy rains have interfered with its early start and the middle of December has been indicated as the probable date of general commencement. A loan of $50,000,000 has been floated in America to assist the Cuban sugar industry, and this is expected to aid the planters and millers considerably in taking off the new crop. In the middle of November there was only 177,865 long tons of old crop sugar left in the island, which should be speedily absorbed. The low level of these stocks as compared with the one and a half millions of a year ago should encourage the producer to ask for a good price; their idea for February shipment, according to Connal & Co., is about 17s. 1½d. c.i.f. This is more than the British refiners fancy paying for the moment, but it remains to be seen whether Cuba will not be able to dictate her own price before long. In any event she should secure a good price for her 1922-23 crop since she will have no difficulty in marketing it, in view of the threatened excess of world consumption over world production.

American Control of Cuban Production.

In our July issue [1] we gave, on the authority of Mr. TRUMAN G. PALMER, a summary of the American holdings in Cuban sugar properties. It was there stated that 85 mills were American-owned, of which 49 were controlled by American seaboard sugar refining companies, and that these 49 mills had a total output equal to 2,331,033 short tons, or 53 per cent. of the total sugar production in Cuba for the 1920-21 crop. The other American interests independent of the U.S. refiners controlled 785,909 tons. Similar figures were advanced in Congress last August by Senator SMOOT.

But since then in the *Economic Bulletin of Cuba*, [2] a writer has adduced figures and disclaimers from the various refining interests that seem to point to a much smaller holding than the two and a third million tons above mentioned. The actual indisputed fact, says this writer, is that the only Cuban sugars controlled directly by American refiners are as follow: American Sugar Refining Company, 115,000 tons; Warner Sugar Refining Company, 110,000 tons; Revere Sugar Company, 190,000 tons; and the W. J. McCahan Company, 115,000 tons; or in all 530,000 short tons, not 2,331,035 tons. Out of the total American-owned sugar in Cuba, given in the schedule introduced in the Senate as 3,116,942 tons, four refiners out of the ten control directly or indirectly approximately 17 per cent. As a matter of fact all these ten refiners of cane sugar buy the great bulk of their raw sugar in free competition on the open market.

The above is their answer to Mr. PALMER, but while it may be technically accurate, it does not seem to us to dispose entirely of other ways and means of control, and these probably exercise more influence in favour of the refining interests than the bare figures of finance would indicate.

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[1] *I.S.J.*, 1922, 340. [2] Vol. II., No. 3 (October, 1922).

The Sugar Problem in Australia.

Various cabled advices to the press from Australia received in London indicate that there is so much growing hostility to the Federal Government renewing the present agreement with the cane growers and producers of Queensland (whereby the Government takes over the sugar at a fixed price) that it is almost certain it will not be renewed when it expires next year. As our readers will be aware, sugar produced in Australia by white labour cannot compete with tropical sugar produced with cheaper coloured labour, in fact the cost of production by white men has been such that the retail price has ruled for some years at 6d. per lb., equal to £56 per ton. This high price naturally conflicts with the interests of the trade sugar users in the southern States of the Commonwealth who count on getting a cheap supply of sugar for the jams and other canned goods they export to the world's market. The two points of view are difficult to reconcile, and Queensland is in a minority amongst other States in the Federal Parliament, so it is unlikely she will be able to maintain the existing favoured position of her staple industry for much longer. The Government have decided, as an alternative to the control of the sugar industry, to raise the tariff from £6 to £9 6s. 8d. per ton, while the retail price of sugar was to have been reduced on November 1st to 5d. per lb. It is hoped on the Government's part that this increase in the tariff will enable the producers to make a profit and will at the same time free the industry from Government control. As our Australian correspondent pointed out in our October issue, there is a good chance of the sugar industry in Queensland carrying on profitably with the retail price at 5d. per lb., providing a number of reforms chiefly on the agricultural side are carried out so as to cheapen further the cost of production. But it is clear that the industry will be badly hit for the time being when the agreement expires next year.

In the course of a debate in the House of Representatives, the Australian Prime Minister stated that the price of 5d. per lb. was based on the following figures: Cost to growers, 2·07d.; milling, 1·178d.; freight, refining and rebate brought the cost up to 4·27d. per lb. Wholesale profits raised this to 4·5d., while the retailer himself took the final ½d.

Under the three-year agreement expiring next March the producers were guaranteed £30 per ton, the refiner took £6 (out of which he paid £2 for freight), the Government took £8, £3 went to the wholesaler and £9 to the grocer. These figures are of course only approximate, but they indicate fairly accurately the way the price rose from £30 to £56 twixt producer and consumer.

The same debate above referred to brought out some figures as to the cost to the Federal Government of importing foreign sugar during the control period. About 60,000 tons in all was imported, chiefly from Java, Formosa, Mozambique, Fiji, Peru, Mauritius, and Cuba. The lowest price paid was £14 per ton f.o.b. for some Peruvian sugar, while the highest was £84 10s. f.o.b. for a small parcel of Java sugar in April 1920. The last import was made in November 1920.

Success of the Petree Process.

The Petree Process[1] of obviating the use of filter-presses in the sugar factory which was first devised in 1916 has, it is clear, been making rapid headway in the sugar industry throughout the world. It may indeed be asserted that few if any of the important innovations in sugar production brought out from time to time have met with such speedy success in the first years following their introduction as has this Australian invention. Mr. PETREE who has lately returned to Australia after three years' absence, pushing the introduction of his scheme in various cane sugar countries, has no reason to be dissatisfied with the results so far achieved. He has seen his process installed or ordered to be installed, in factories in South Africa, British Guiana, British West Indies, Mauritius, Réunion, Cuba and Hawaii. Altogether over 40 factories in various parts of the world have taken out licences to work the Process. The latter is claimed to save about $2 per ton of sugar produced, and if the results at the Central Soledad, Cuba, where an installation is being erected, should lead to the general application of the process in the big Cuban centrals, the saving on the above basis would naturally be a very considerable sum annually. Where installations have already got to work, the result has been in Mr. PETREE's opinion very successful and what is more as increased knowledge of the varying conditions has been acquired, the improvement in the results has been enhanced. At the present moment Mr. PETREE is in Honolulu superintending the erection and opening of Petree plant at two factories which together are capable of turning out 100,000 tons of sugar yearly.

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[1] For details, see *I.S.J.*, 1919, 33-34.

Various Company Affairs.

During the Autumn the well-known firm of Sir J. L. HULETT & SONS, Ltd., the Natal sugar producers and refiners, offered the public an issue of 225,000 seven and a half per cent. cumulative preference shares of £1 each. These were part of an increase of capital of £200,000 proposed by the directors partly to enable them to finance the large stocks of sugar they were compelled to carry, but chiefly to extend their operations in Zululand. This increase raises the capital of the Company to £900,000. For the year ended June 30th last the Directors declared a dividend of 8 per cent. on the ordinary shares.

The last annual report of Leach's Argentine Estates disclosed a trading loss of £2,630, due in the main to frosts damaging the growing cane. To this loss there was added £36,458 for depreciation and £45,589 for Debenture interest, Directors' fees and London charges. The Company has however been able to recover as much as £85,358 in excess profits tax, which results in a small credit balance of £1038. Naturally no dividend could be declared. The total amount of sugar produced by the company last season was 11,616 tons; but selling prices were poor owing to the importation of 80,000 tons of sugar into Argentina, a quantity that made supplies in excess of the normal demand.

The ST. MADELEINE SUGAR COMPANY, Ltd., Trinidad, reports some slight improvement over the previous financial year, but at the beginning of the last one they had a debit balance to carry forward of £95,228. For the twelve months ending June last a profit of £9777 was made after payment of debenture interest, thus reducing the deficiency to £85,264. The estates have suffered in the near past from reduced cultivation, the result of labour difficulties, but serious efforts are being taken to get back to pre-war conditions. Expenditure has been largely cut down, the cost of stores has fallen, while the recovery of sugar from the cane shows a marked advance on any previous record. During the year under review the price of sugar fell from £26 per ton to about £15 10s.; but it may be assumed that the next accounts will show a more profitable return in view of the recent rise in prices.

Fifty Years Ago.

From the "Sugar Cane," December, 1872.

Sulphur in the form of sulphurous acid gas first began to be used in the cane sugar industry in Louisiana about the year 1860, using Stewart's process,[1] and gradually ousted the bisulphite of lime method which at that time had become established in the leading cane producing countries. In this issue of our predecessor, a lecture by Colonel Stewart to the planters of Demerara was reported, and it is not uninteresting to reprint some of his remarks. "The working of the syrup under vacuo was perfect, crystallizing very rapidly, and quite freely, and without any colouring matter, producing a very fine sugar, very similar to what is made in the French usines after the use of animal charcoal; and with a slight application of water in the centrifugals became nearly equal to loaf sugar in colour . . . . With the white sugar the readings were exactly the same as with sugar candy, and such was the purity of this sugar that the standard solution of 16·350 grms. to 100 of water did not require any purifying agent to enable me to test it in the polariscope. . . . . ."

Under the heading of "A curious Result obtained in the Microscopic Examination of a Cane Soil," Dr. T. L. Phipson said that on searching for diatoms in a Barbados soil to determine whether it had been treated with Peruvian guano he was surprised to observe the presence of certain forms quite new to him. Under a power of 200 diams. these bodies appeared more or less globular in shape, but terminated at one side in an elongated point, and at the opposite side by an abrupt point, being something in shape like a pear with a long tapering stalk, though some were curved like a retort, and others straight. They were of various sizes, but quite invisible to the naked eye; and appeared to be brilliantly metallic, like polished steel. As to the origin of these microscopic structures, Dr. Phipson explained that on the estate from which these soils were derived, megass ashes were thrown on the cane fields, and he gave it as his opinion that the pear-like globules had originated from the bars of the furnaces in which the trash was burned. It seemed strange, however, that these metallic globules, so brilliant and so minute, had been present for at least two years in this surface soil without undergoing the slightest oxidation. "This fact shows how slowly the oxydizing action of air and water effects itself in these dense clays as compared with this action in sand and other porous soils, and consequently that the manure applied to such soils must contain within itself not only material to afford porosity, but a certain amount of oxydizing power also. . . . . ."

There were also two papers of some interest to the chemist. The first was an account of Knapp's well known method of estimating reducing sugars by means of an alkaline solution of mercuric cyanide, the titration being performed somewhat in the same way as when using Fehling's solution, and the end-point ascertained by means of ammonium sulphide dropped upon a piece of blotting paper. It was stated that "A great number of determinations of sugar, ... have proved that although this method cannot claim any greater precision than that of Fehling, yet that it is quite as exact. The new method possesses the advantage that it requires less time to carry it out, and that foreign matters have no influence on that of cyanide of mercury. . . . . ." Regarding the other paper, this was by O. Wachsmuth, a Belgian chemist, who advocated the addition of an alcoholic solution of tannin to the polarimetric assay liquid, after it had been treated with a few drops of lead subacetate.

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[1] U.S. Patents, 22,590 and 24,961, of 1859.

Rats, and their Suppression on the Sugar Plantation.

By C. L. CLAREMONT, B.Sc., F.I.C.,
late Research Chemist on Rat Destruction, Ministry of Agriculture.

(*Continued from page 581.*)

PART III.

The actual problem of rat repression is one of considerable difficulty—indeed, rat destruction has been carried out for many years by empirical methods without conspicuous success in permanently reducing the pests. As we have already pointed out, the problem has received little serious scientific attention. A certain amount of work has been done in Europe, mainly directed to the production of suitable cultures of germs to use for direct infection of the rodents with disease, and recently the use of poisons has been investigated both in Great Britain and the United States.

Before describing in detail the various means available for dealing with rat infestations, it may be said at once that there is no royal road to success, nor is there any wonderful specific, whether poison, virus or rat-catching device, which is capable of producing the marvellous results so often alleged in the advertisements. Success can only be achieved (and that sometimes but a partial one) by constant attention and thoroughness.

CAUSES OF INFESTATIONS.

Rat suppression and rat destruction are not precisely synonymous terms. Rat destruction is after all only a palliative, a necessary one it is true, but it is seldom a complete success unless steps are taken to deal with the cause. Rats and mice like all other animals must have food, water, and shelter to breed and multiply and many infestations arise because of human carelessness in this respect.

The first point then in dealing with an infestation, whether large or small, is to endeavour to find out why it has occurred and what factors are contributing to its persistence. It is not always possible to ascertain the ultimate cause but it is generally possible to do a great deal to reduce contributing factors. Available food supplies should as far as possible be protected from attack by being kept in proper rat proof buildings or receptacles; rubbish which furnishes both food and shelter must be got rid of; and accumulations of stores, etc., which though not actually edible yet form ideal nesting places, should be turned over and re-stacked so that they do not form hiding places. Undisturbed nesting is one of the most important factors in keeping up an infestation. In the case of buildings, in urban areas particularly, defects in drainage and construction should always be searched for and remedied. Once the supply of fresh invaders is cut off it is comparatively easy to deal with those remaining.

METHODS OF RAT DESTRUCTION.

Practical methods of rat destruction are conveniently discussed under four headings: (1) Hunting; (2) Trapping; (3) Poisoning; and (4) Artificial infection by disease or virus method.

(1) *Hunting.*—This is possibly the oldest of all methods, dogs, cats, ferrets and mongooses having been trained for this purpose. The method is however of very limited application, and is most useful in the country in dealing with such places as infested stacks at threshing time. Ferrets can sometimes usefully be employed in stores where the rats are living between cases, etc., and not in holes in the floors and walls. It is interesting to note that in Jamaica mongooses were

introduced in order to cope with the rats on the sugar plantations, but they soon became a worse plague than the rats owing to their depredations in the poultry runs.[1]

(2) *Trapping.*—It is quite impossible within the scope of this article to deal with all the various traps used for catching rats; nor is this necessary, for the success of trapping depends more on the trapper than the actual form used. A careful and cunning worker will get better results than a casual worker even with an inferior article.

Traps may be divided into two classes, those designed to kill or take single rats, and those capable of killing or taking many rats. Of the former class, the spring break-back type is most popular. It is easy to set; does not take up much space; and as a general rule kills the rat outright.

There are many forms of traps for catching more than one rat which vary considerably in design and complexity. The barrel-shaped wire trap is one of the commonest, but unless carefully made and of suitable dimensions, especially at the entrance and in the springing of the platform, is comparatively useless. Both the Zoo experiments conducted by Mr. BOULENGER,[2] and similar observations by officials of the Plague Committee of India[3] confirm the importance of these points.

A very useful form of trap which we have used successfully on many occasions is that known as the "Varnish" or "Birdlime" trap. It consists of sheets of strawboard about 15 in. × 12 in., on which is spread lithographic (rat catching) varnish or birdlime to a depth of about $\frac{1}{8}$ to $\frac{1}{4}$ inch (1lb. makes 4 or 5 traps), leaving the edges clear for about 1 in. all round, any suitable bait such as fish, bread or cheese being placed in the centre. Each of these traps will take many rats, the dead rats can be removed daily and the trap re-laid, a good varnish remaining effective for several days.

There are however, difficulties in trapping rats in sufficient numbers to clear really badly infested places, moreover rats are very cunning and soon become wary to traps, even to varnish.

(3) *Poisoning.*—Poisoning is by far the most important method. It can be used with due precautions anywhere, and in our opinion (when properly applied) is the most successful of all methods for rapidly reducing rat infestations.

Where the conditions are favourable "gassing" is a very useful method, particularly for treating such situations as infested banks, refuse tips, etc., and is largely employed in the fumigation of ships for vermin. It is not however so useful for houses and buildings, owing partly to the difficulty of confining the gas, and partly because the rats die in the holes and are liable to smell. Several gases have been used, *i.e.*, chlorine, phosgene, hydrocyanic acid, carbon disulphide and sulphur dioxide, but of these only the last two are in general use for this purpose. On the whole sulphur dioxide is the safest and best to use for rat destruction,[4] it is easily generated and is not very dangerous to the operator; at any rate it is sufficiently irritating in safe concentrations to warn him not to remain in the vicinity.

This method has one great advantage over all others in that it kills not only the adults, but also the females and young in their nests.

To come to the use of poisoned baits, while there is no great difficulty about poisoning rats so far as merely killing them is concerned, there are many points to be considered before it can be said that any particular poison is suitable for the purpose, and as the rat feeds on our food and lives in close association with us, it is desirable that any poison used should be relatively harmless to human beings and to domestic animals, and capable of being applied to the different situations the rats inhabit.

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[1] BOELTER: "The Rat Problem"

[2] "Methods of Rat Destruction" (The Zoological Society, London.)

[3] Communicated to the Author privately.

[4] Machines for producing this gas are on the market, and a very simple home-made article is described in Leaflet 244 of the Ministry of Agriculture.

The poisons which have been most generally used in the past are phosphorus, arsenic and strychnine. Since rat destruction has been a matter of official concern it has been realised that these dangerous substances have many disadvantages and search has been made for more satisfactory substances which, while toxic to rats, will give a reasonable margin of safety to human beings and other animals. It is extremely unlikely that any substance will kill rats and yet be entirely innocuous to other animals irrespective of the quantity taken.

The solution of the problem lies in the relative danger to rats as against other animals. In general, the lethal dose of any poison depends on the size of the animal. Fortunately the rat is a very small animal, and happens to be peculiarly susceptible to some poisons, said to be due to the fact that it cannot vomit or at any rate does not readily do so.

Before dealing with the properties of the poisons in general use it may be as well to state what in our opinion are the essentials for a practical poison.

(*a*) It must be relatively harmless to domestic animals.
(*b*) It must be effective on rats and mice, that is reasonably small doses must kill for certain.
(*c*) It must be cheap and readily procurable in suitable form.
(*d*) It should be tasteless or at any rate have no repellant taste.
(*e*) It must be easy and clean to handle and capable of being readily incorporated with other ingredients to form attractive baits.
(*f*) It should keep well and retain its toxicity in any climate.

There are not many poisons which satisfy all these conditions. The more dangerous poisons mentioned above can be ruled out under the first condition. Many accidents have been traced to their use, and they have another serious disadvantage, that is, that when used in buildings owing to their rapid action rats often die in their runs and holes. Out of doors this does not matter so much, but even then there is a risk of domestic animals, pigs in particular, eating the poisoned rats. Owing to the low dose which is fatal to large animals, casualties will thus occur.

In this and indeed most countries there are very properly restrictions on the public freely purchasing poisions containing arsenic or strychnine; but phosphorus can be obtained without any formalities, and this is no doubt largely the reason for its popularity. It is often very efficacious though its use is attended with some risk of fire, especially if improperly prepared. As regards strychnine recent investigations in America suggest that it is not so efficacious for rats as might be supposed, though this is not the case with mice.[1] Arsenic is much favoured by rat-catchers and game-keepers, but there is a good deal of evidence that despite its tastelessness rats are very suspicious of it, hence the general practice of preliminary baiting with unpoisoned feed before actually putting down the arsenical bait.

Of the many less dangerous substances tried, experience has proved that barium carbonate and red squill (*Urginea maritima*) are the most useful. Baits containing one or other of these substances are becoming increasingly popular and their use is strongly recommended by the Ministry of Agriculture, not only because of their relative safety but also for their general convenience.

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[1] *U.S. Dept. Agric. Bull.* 1023, Jan., 1922.

Both these substances have been the subject of a good deal of research work directed to this special use, and it is fairly well established that their margin of safety is much greater than is the case with the better known poisons. In the case of barium carbonate, excessive quantities will undoubtedly kill larger animals, but if proper care be taken there is no great risk attached to its use. Indeed in many cases within our personal knowledge large quantities have been used without any accidents. In other respects barium carbonate satisfies the conditions extremely well.

Red squill has only comparatively recently been used in this country, though it has been in use on the continent for some years. It is known to be very toxic to rats, and practically innocuous to other animals. So far as we are aware, there are no recorded cases of domestic animals being killed by it; but possibly large doses would make them vomit and this fact alone would prevent any further action.

This poison is generally put on the market in the form of a liquid extract of red squill, and sold under various fancy names. It was generally supposed that this substance was not very constant in its action and was liable to deteriorate somewhat rapidly. Experimental work at the Rat Research Laboratory, Ministry of Agriculture, (now closed) did not confirm this. Laboratory trials gave consistently good results, and baits containing the drug in the form of both powder and raw bulb were successfully manufactured and were productive of excellent results in practice. Indeed it is equal to barium carbonate in this respect. The main disadvantages attached to its use are: (1) that it is somewhat difficult to be sure of getting the right kind of bulbs; and (2) that the preparation of the material has to be carefully carried out to ensure getting an active product which will keep well. Consequently baits containing this substance are rather more expensive than those containing barium carbonate.

The problem of successful poisoning is by no means ended with the choice of a suitable toxic agent, as the next step is to prepare a bait acceptable to the rats or mice, which will contain such an amount of the poison that, while one single bait willl be ample to kill a rat of average size, there is insufficient present to harm domestic animals. Experimental work indicates that each bait should contain two to three times the least quantity necessary for one rat and be of such a size that a hungry rat will consume the whole of one bait.

Many different materials have been used for the basis with which to incorporate the poison and the attractiveness of various flavouring substances tested both in the laboratory and in the field. A point of considerable practical importance is to have the baits in such a form that they are ready for immediate use without any waste of time such as is involved in spreading a paste on bread. If the baits can be made so that each single bait is separate, and contains just the correct amount of poison, so much the better. It often happens that if treatment of an area has to be kept up for long periods that the rats get tired or suspicious of any one bait. It is well therefore to have occasional changes of the form in which the bait is made, and by this means greatly improved results can be obtained.

In this connexion it is interesting to note that *Mus rattus* will not always take baits which are readily taken by *Mus decumanus*. This is specially noticeable in the case of simple pastes, but it was noticed that they took a form of biscuit bait very much better.

(4.) *Virus method or artificial infection with disease.*—This method has now been before the public for several years. On its introduction it was hailed as a great advance in scientific rat destruction, but unfortunately these hopes have not been altogether realised. The method depends on laying baits containing active disease germs which will be fatal to rats without being dangerous to human beings and domestic animals. Of course, just as with ordinary poisons, the method ultimately depends on the attractiveness of the bait.

The makers of these preparations claim that they are quite harmless to human beings and domestic animals but considerable doubt has been thrown on this point. Be this as it may, there are other objections to this method namely: (1) low percentage of deaths due to the varying susceptibility of the rats to the disease; (2) rats taking doses too small to kill tend to become immune to the germs; and (3) the possibility of the germ developing increased virulence in its passage through the rat. The subject is one on which to keep an open mind, for even if the present viruses are not all that could be desired it is not impossible that bacteriological science may perfect this method in which case it would be a very valuable addition to our weapons for fighting the rat menace.

PRACTICAL METHODS OF APPLYING TREATMENT.

The practical application of these methods of rat repression calls for a certain amount of thought and organization. Many failures attributed to the method or bait used are not infrequently due to improper or inadequate application on the part of the user.

When an area is to be treated for rat infestation, some responsible person should be chosen to supervise the work, if necessary with assistants in the case of very large areas, each one being responsible for an allotted portion, the man-in-charge exercising general supervision and being responsible for the plan of campaign. Too often rat destruction is turned over to any spare hand, without regard to his fitness for the work.

The first points to investigate are: (1) The cause of the infestation; if this is found out it should be dealt with on the lines already indicated; (2) the species of rat to be dealt with. If specimens cannot be obtained for identification, the habits and environment should give a clue; and it is useful to note carefully any dejecta found, those of *Mus decumanus* being larger and more spindle shaped than those of *Mus rattus* which are smaller and blunter at the ends. Then all holes and runs and in the case of a building any defects making it vulnerable to rats from outside, which will require making good, should be noted carefully.

When a survey of the position is complete it is then necessary to consider what method or methods of attack will be best suited to the conditions. It is often useful to combine trapping campaigns with poisoning. Whichever method is selected, it must be thorough, and the attacks repeated at fairly frequent intervals until the pests are well under control, and finally exterminated or at least kept at such a low level that they cease to be a menace. If the pressure is relaxed they will undoubtedly regain the upper hand. Haphazard and inadequate treatment are almost worse than useless, and do not repay the time and money spent on them.

A few hints on the proper way to lay poison baits may be useful. One of the commonest mistakes made is that far too little bait is used; this is a frequent cause of disappointing results. A rough guide is to estimate the number of rats supposed to be present in the area to be treated and then put down at least ten times as many baits, the object being to get as many baits as possible taken at the first treatment, and so get a marked reduction of the pests straight off. Of course all the baits may not be taken; in fact they should not be for if they are it shows that many rats did got get any. Under favourable circumstances, if 50 to 75 per cent.

of the baits are taken it may be considered a good result. Many people carry out a preliminary baiting with unpoisoned bait; but our personal opinion is that this is a waste of time and material, for if the feed is taken, the rats might just as well have poison at once, and if the baits are made sufficiently attractive this is exactly what does happen.

In laying the bait the following points should be noted: Place the bait well down all the rat holes found, in the runs and in any places where the rats are known to collect, such as near their drinking places, etc. When laying bait on the surface, it should not be put down anywhere, but along walls and such-like situations, as rats generally follow such tracks. If there is no natural cover behind or under which to put the bait, it is safest to place pieces of wood, brick, etc. over it in such a way that a small tunnel open at *both* ends is formed, this will serve to protect the bait from being accidently taken by domestic animals. Always use a clean stick or spoon for handling the bait; never use the naked hands, as rats are inclined to be suspicious of human scent. It is hardly necessary to say that when baiting a place, it is advisable if possible to remove or cover foodstuffs which the rats are in the habit of attacking.

The success of a treatment must not be judged by the number of corpses found, particularly when using barium carbonate or red squill, but by the proportion of bait which has been taken and by the gradual reduction of the nuisance.

After three or four days it is a wise precaution to collect as much of the unconsumed bait as possible and *burn* it. It should not be necessary to add that every care should be taken to store bait in a safe place where children and animals cannot touch it.

A second treatment is advisable after about two or three weeks, and then from time to time according to the success of the operations, as time goes on the bait used can be much reduced and the intervals lengthened; but observation should be kept up even when a place has been cleared so that prompt measures can be taken to deal with re-infestation if it arises. In fact, an occasional preventive dressing with bait is by no means a bad plan.

Where several adjoining properties are infested, it is a great advantage to endeavour to arrange co-operation between the various owners, as otherwise the work is rendered much more difficult.

Working on the lines indicated above, very substantial success should be achieved. It is true that it entails a certain amount of time and trouble, and the use of a considerable amount of bait, all of which cost money. Unfortunately rat destruction is bound to cost money; but on the other hand the extent of the damage done by these destructive pests is often not realised and is so considerable that an efficient campaign of repression is an undoubted economy.

In conclusion, we trust that these hints may be of service in aiding planters and others to deal with the rat problem, for situated as they are far from the centres of research on this subject and often without any local source of supply of up-to-date preparations[1] the solution ot the problem goes by default, the result being a vast loss of potential stock and materials. With the present economic position throughout the world no one can afford to have their stock and buildings damaged by what is a largely preventible cause. Energetic and persistent war on the rat not only repays the firm or individual undertaking it but materially assists in adding to the casualties in what is or should be a world wide campaign.

(Concluded.)

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[1] Those bearing the "Klearwell" brand are reliable, having been made under the supervision of the writer of these articles, the agents for which for the sugar industry are the Sugar Manufacturers' Supply Co., Ltd., 2, St. Dunstan's Hill, London, E.C. 3.

The "Darco" Decolorizing Carbon Process in Cane Sugar Refining.

By HOLLIS H. DANN,
Sugar Technologist, Darco Sales Corporation, New York.

There are several different methods of using Darco in the refining of cane sugar. The present article deals with the production of a standard granulated sugar by means of Darco alone, either at a raw sugar mill in the tropics, or at a refinery located near the large centres of population.

In a refinery now using bonechar, a small percentage of Darco may be employed in place of the ordinary method of defecation, the bulk of the colour in the melt before passing the liquors through the bone filters being removed in this way. By utilizing the blow-up tanks, and if possible the presses ordinarily used for clarification by lime and phosphoric acid or kieselguhr, very little additional equipment would be required. In view of the fact that such a process would eliminate some of the bonechar equipment now in use, this process would especially appeal to refiners who contemplate increasing the capacity of their plants.

The surplus bonechar equipment could be readily utilized for the increased tonnage; while the cost of the additional blow-up tanks, filter presses, and the Darco revivification furnace, would be small compared to the cost of the standard bonechar equipment necessary to handle the increased melting.

A raw sugar manufacturer desiring to produce standard granulated sugar at his factory in the tropics may use Darco equipment of such capacity to handle slightly more than 50 per cent. of his daily output of raw sugar. He could store the remaining portion of his production at the factory until the grinding season is finished. Refining could then be continued during the "dead" season, not only handling the remainder of the raw sugar produced at that mill, but also purchasing raw sugar from neighbouring plantations.

GENERAL OUTLINE OF THE PROCESS.

Although decolorizing carbons are now used throughout the world in many different industries, very little has been written on the proper methods of application of them in the factory, and especially is this true of their application to sugar refinery practice. Because the users of decolorizing carbons are not sufficiently familiar with the technical principles underlying their proper application, they often expect results that are manifestly impossible to obtain, and do not take advantage of many characteristics of the carbon that could be utilized to decided advantage.

We are, therefore, outlining a process for the manufacture of standard granulated sugar from raw sugar by means of the decolorizing carbon, Darco. Many of the points discussed in this report may also be of interest to users of Darco in allied branches of industry such as the production of glucose and maltose syrups. The following are the principal steps in the refining process:—

1. Mingling and washing the raw sugar.
2. Melting.
3. Mixing Darco with the melt.
4. Filtration of the Darco-treated melt.
5. Preparation of the exhausted Darco for the furnace.
6. Revivification.
7. Boiling and curing the sugars.

We will discuss in detail each of the first six steps; the seventh, that of boiling and curing the sugars, is similar to regular refinery routine.

1. *Mingling and washing the raw sugar.*—It is impracticable in the production of standard granulated sugar to apply a decolorizing carbon directly either to defecated juice from the mills, or to re-melted raw sugar liquor of 96° purity or less. However, by mingling the raw sugars with a hot saturated sugar solution, the coating of molasses containing the greater part of the impurities present on each grain of sugar is removed on centrifuging. The sugar in the centrifugal is then washed with water, and the resulting sugar of about 99° apparent purity can be melted and the resulting liquor successfully treated with a small percentage of Darco without further defecation.

In the process of sugar refining, Darco, like bonechar, is used primarily to adsorb colouring matter, although other impurities are also eliminated. For many years raw sugar has been washed before filtration over bonechar. Similarly, it is more economical to remove impurities by proper affination rather than with a large percentage of Darco.

If 96-test sugars, for instance, were melted directly and treated with Darco, it would require some 5 per cent. of carbon on the weight of sugar melted to remove the impurities present and produce a water-white liquor. In the process under discussion, only 1¼ per cent. to 1½ per cent. of Darco is required to produce the same result. Since the actual loss of carbon occurs largely in the process of re-burning, it can readily be seen that these losses will be very much greater when working with 96-test sugar, since then more Darco would required to be re-burned per 1000 lbs. of sugar refined. Moreover, the capacity of the re-burning kilns must be triple that required in the other process; likewise the number of filter-presses to handle the filtration of the sugar liquors must be correspondingly increased.

Whether it is to be decolorized by bonechar, Darco, or a combination of the two, the preparation of the melt, or raw sugar liquor, is therefore essentially the same. The raw sugar is mingled with a syrup of about 83° purity, the magma spun in a centrifugal, and then washed to an apparent purity of 98·5 to 99·0°. The washed sugar is carried by a conveyor to the melter; while the "greens" and wash-liquors are separated, the latter to be used in mingling and the former to be boiled to remelt sugar.

2. *Melting.*—One of the important factors governing the rate of filtration and the efficient application of Darco to the melt is the density of the raw sugar solution. Other things being equal, a high density means slow filtration. It is advisable, therefore, to maintain the hot melt at a uniform density of about 30° Bé. (about 60° Brix) in order not to disturb the time cycle of the filter presses. Moreover, a uniform density of the melt results in a more even decolorization, since in factory routine the quantity of Darco added is at all times the same, being determined in part by the cubic contents of the filter presses.

The temperature of the sugar liquor is maintained about 130° F. (54° C.), but just before the Darco is added it is heated to 190-200° F. (88-93° C.) by passing through a heater, or, if already in the mixing tank, by means of steam coils.

The acidity of the melt should be about 0·01 per cent. as HCl, or about 0·003 N. If the acidity is too high it may be reduced in the melter, preferably by a soda ash solution to the figure mentioned above. Soda ash is preferable to lime for the neutralization, as it does not increase the ash of the carbon on revivification. Furthermore, it means a saving in the amount of hydrochloric acid necessary if the Darco is subsequently to be acid treated.

3. *Mixing Darco with the melt.*—After passing through fine metal screens in order to remove coarse particles in suspension, the melt is pumped to large conical-bottomed iron tanks equipped with steam coils and mechanical agitators.

There the Darco may be added either in suspension in water, or in the form of a wet cake as cut down from the filter presses. The former method is preferable, as it reduces labour charges, cuts out the use of at least one filter press, and is infinitely cleaner, the dilution of the melt due to the water in which the carbon is suspended being inappreciable. The water suspension of Darco is kept in constant circulation through the pipe lines by means of a centrifugal pump, while the storage tank is equipped with a mechanical agitator. The ratio between water and Darco circulating in the system is controlled by means of a Bé. spindle. The readings of course do not represent true Bé. degrees, but the relation between the apparent Bé. and the pounds of Darco per gallon is easily determined in the laboratory once for all at various concentrations.

In order to sufficiently exhaust the Darco, it is used a second and sometimes a third time on fresh portions of melted sugar liquor before being subjected to any washing or re-burning. Since the Darco is partially exhausted after the first use, and since a uniform colour in the treated melt is desired, it will be found necessary to decrease the ratio between melt and carbon on successive uses. This is a matter of factory practice, however, and the ratios depend largely on local conditions. The correct figures for any factory may be determined easily through a study of the decolorizing power of the Darco at each stage in the process.

After the first and second uses, the press cake is added directly to the fresh portions of melted sugar liquor in the mixing tanks; after the third, the cake is washed for a few minutes in the press and dropped into a tank of boiling water, where the sweetening-off process is continued.

After adding the Darco to the melt in the mixing tanks, the temperature is raised to 190° F. (88° C.), and maintained there while the Darco and melt are thoroughly mixed for a period of 15 minutes. The decolorization is practically complete at the end of this time, and the liquor is ready to be pumped to the filter-presses.

4. *Filtration of the Darco-treated melt.*—The filtration may be satisfactorily accomplished using the ordinary type of plate-and-frame presses equipped with modern devices for washing the cake.

A good rate of filtration depends principally on two factors:—first, a satisfactory revivification of the Darco after its previous uses; and second, the care and skill with which the presses are dressed and the filtration handled. The filter cloths should be wet, and the press warmed up by blowing with steam before filtration is commenced. The melt should be delivered to the presses at first with minimum pressure, and as the cake inside the press is built up, the pressure should be gradually increased. Just before the press is full, a pressure as high as 60 lbs. per sq. in. can be carried.

It is desirous to maintain a continuous, even pressure during the filtration in order to secure the best results. If the pressure is allowed to drop, and is then suddenly increased, or if the flow of liquor is discontinued and the cake allowed to partially dry out, the rate of filtration of the remaining liquor is greatly decreased.

The use of compressed air in place of pumps for the mixture of melt and carbon has much to recommend it, as the pressure on the presses is more easily controlled.

The decolorized melt, or char liquor, as it is called at this stage, is now passed through secondary filters, usually bag filters, to remove any carbon that may have come over in the clear liquor due to a burst filter cloth, faulty dressing of the press, or possibly to needle-holes in a patched cloth. In any case, the amount of Darco passing through is very small and is readily removed in the manner described.

The char liquor is now perfectly clear, with very little or no colour. It may be used in the manufacture of granulated sugar, or for the production of the special grades turned out by a large refinery.

The quality of the granulated sugar produced by this process is equal to that produced by the best equipped bonechar refineries.

5. *Preparation of the Darco for the furnace.*—After two or three successive uses, the nearly exhausted Darco is dropped from the presses after a brief washing with hot water in the press itself. The cake is then introduced into a tank of boiling water. This tank is equipped with a mechanical agitator, and the mixture of carbon and water is vigorously agitated for at least half-an-hour, the temperature of the water being maintained around boiling point. The contents of the tank are then pumped to either a plate-and-frame or a continuous filter press, the latter being preferable.

The above process of sweetening-off can be carried out in the first press, but the washing must then be continued for 24 hours or more before the organic matter is properly removed. Moreover, if channeling occurs, the washing is highly inefficient. The method outlined above results in a great saving of time, and at the same time ensures proper washing of the Darco. In case a plate-and-frame press is used to collect the washed Darco, the washing can be continued for a short time in the press, and the cake should then be blown with live steam and compressed air to reduce the moisture content. The continuous type of press affords a saving in labour; and, as the name implies, can be operated continuously.

At least 2000 gallons of water should be used with each 1000 lbs. of Darco washed. This is far more water than would be necessary if the only object in view were to recover the sucrose in the cake. However, it must be kept in mind that not only the sucrose, but also as much as possible of the organic non-sugars and gums adsorbed by the Darco from the melt must be removed before sending the carbon to the revivification furnace. Only by a thorough removal of these impurities is the Darco properly prepared for the revivification process; a thorough washing is indispensable for a successful re-burning, and upon a successful re-burning depends the normal rate of filtration of the melt during the following cycle.

In case the Darco has not been sufficiently washed, the lot should be returned to the tank for further treatment rather than attempt to run it through the furnace.

By determining the apparent specific gravity on small quantities of the dried cake, the efficiency of the washing process may be further controlled from time to time.

Since the optically-active gums and invert sugar may affect materially the testing of the washed Darco, better indication of the fitness of the carbon for the furnace may be obtained by inverting the water extract from the cake and titrating a given quantity against standard Fehling or Soxhlet solution. Using the Meissl and Hiller table, an arbitrary figure is obtained, which, in comparison with the result for a satisfactorily washed cake, will give a rough indication of the amount of harmful impurities present.

Owing to the fact that the sweet-waters obtained as above stated remove a considerable amount of gums, it is advisable to concentrate the bulk of them in an evaporator and use the resulting liquor in boiling re-melt sugars, rather than to use this sweet-water for melting, thereby re-introducing into the system a large portion of the gums previously removed by the Darco.

For instance, after the grinding season is over, it might be good policy for a factory to run its quadruple effect as two double effects, one half working on sweet-waters and the other half concentrating the char liquor to about 33° Bé., thus decreasing the load on the vacuum pans and cutting down the time of boiling each strike.

6. *Revivification of the Darco.*—This is best done by re-burning, which is the most satisfactory and economical method of revivification and is abolutely essential when large quantities of Darco are employed in the process, as is the case with sugar refining.

Under certain conditions it may be advisable to interpose treatment with concentrated hydrochloric acid between the water washing and the re-burning kiln. The object of such an acid treatment is to reduce the soluble ash content of the Darco, for a certain amount of mineral matter, largely iron, is adsorbed from the sugar solutions and is not removed by water washing alone.

This acid treatment could best be applied to a portion of the Darco in process each day, otherwise it would have to be delayed until the refinery was temporarily closed down, a most unsatisfactory method of procedure

The re-burning of Darco used on melted cane sugar can be accomplished in a kiln composed of horizontal closed retorts, discharging into a tank of water to cool down the carbon and prevent air from entering the furnace at this point. Drying is previously effected in open pans heated by the the exhaust flue gases of the kiln, in order to reduce sufficiently the high moisture content of the carbon cake as it comes from the filter presses. An automatic feeding device is recommended to ensure an even feed of material to the furnace, and to reduce the amount of air entering with the Darco.

A furnace of the type described above, having a double bank of three retorts, pre-drying tube and pre-drying pan each (six retorts in all) will re-burn at least 7000 lbs. of Darco in 24 hours.

The necessity for careful and intelligent operation of the revivification process cannot be overestimated, for upon the proper revivification of a decolorizing carbon depends not only the decolorizing power, but likewise a more important factor, viz., the filtering capacity. By this term we mean the condition of the carbon as judged by its behaviour on filtration during the following cycle. If the revivification has been well done, a good rate of filtration results.

Incomplete re-burning of the carbon is much more objectionable than over-burning, as far as the subsequent rate of filtration is concerned. We have several means of keeping a check on the work of the furnaces, the principal ones being the "soda test" and the decolorizing power of the revivified Darco.

The former is a modification of a test used on revivified bonechar in sugar refineries for many years past. As modified it consists in heating 3 grms. of the dry revivified Darco with 100 c.c. of 10° Bé. sodium hydroxide solution, the heating being continued for two minutes after reaching the boiling point. The solution is filtered off, cooled, and a portion of the solution 12·5 mm. in depth is read on a Hess-Ives tintometer. The lower the colour reading, the better the revivification. This test is for under-burning of the carbon.

Over-burning, on the other hand, is more difficult to detect. By calculating the numerical product of the apparent specific gravity and percentage of ash of the carbon after each revivification, we can detect over-burning by a marked increase in the resulting figure, coupled with a decrease in the decolorizing power of the Darco.

CONCLUSION.

Briefly summing up the salient points of the preceding discussion, we particularly emphasize:—

1. The raw sugar should be mingled and washed to as high a purity as practicable before treating with Darco.
2. The filtration should be under careful supervision.
3. A check filter should be used to remove any particles of carbon coming through the first presses.
4. The exhausted Darco cake should be thoroughly mixed with a large quantity of boiling water, in order to eliminate as completely as possible soluble organic matters before sending the carbon to the revivification furnace.
5. The revivification process demands careful mechanical and chemical control. It should be recognized that the revivification furnace is the key to successful refinery operation.

Determination of the True Brix Degree of Molasses by Calculation.

By CHARLES MÜLLER,

Formerly Chief Chemist, Société des Sucreries d'Egypte.

It is recognized that the determination of the water in molasses constitutes a delicate, tedious, and often uncertain operation on account of the many precautions demanded in order to yield results more or less approximating to the truth.

Chemical control involving the use of the "apparent" value may be absolutely insufficient; and the "true" analysis of the molasses discarded by the factory is often a matter of great interest; for example, when the method of clarification has been changed, the ratio of the organic to the mineral matter thus being modified; or when the daily tonnage is increased, a certain diminution of the time taken for curing, and an alteration in the composition of the massecuites, thus being caused.

Examination of many hundreds of analyses carried out during a period of 25 years, analyses to which every care had been given, has led us to establish an empyrical relationship between the true and the apparent values. For the same factory and the same mode of manufacture, the following ratio exists in the case of the molasses discarded: $\frac{AB - TS}{TB - TS} =$ a constant, AB and TB being the apparent and true Brix values, and TS the true sucrose.

This constant is almost invariable within the limits of the exactitude of analyses carried out in the best possible manner. Sometimes (and it is natural) slight progressive variations may be observed from one year to the next, or even from the beginning to the end of a season, though in general this constant hardly varies within an interval of 8-10 days. By combining this mode of calculation with the author's rapid process of determining sucrose by the bismuth reagent,[1] a process which gives results entirely in accord with the invertase method described by OGILVIE,[2] the true purity of a molasses may be found in 20 mins.

Here, for example, is a table giving the constant as established during the period 1904 to 1914, in three factories, denoted by the letters A B and M:—

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[1] *I.S.J.*, 1916, 274.

[2] *I.S.J.*, 1911, 145; 191[illegible], 89.

Factory.	Year.	Constant.
B	1904	1·22
”	”	1·23
A	”	1·23
”	”	1·24
”	1906	1·23
”	”	1·25
”	”	1·24
”	”	1·23
M	”	1·22
A	1907	1·21
”	”	1·22
M	1908	1·23
”	”	1·24
A	”	1·23
”	”	1·23
B	”	1·25
M	1909	1·23
A	”	1·22
”	1910	1·25
M	1910	1·24
A	1911	1·25
M	”	1·23
A	1912	1·26
”	”	1·25
B	”	1·25
”	”	1·26
M	”	1·27
”	1913	1·27
A	”	1·27
M	”	1·28
”	”	1·26
A	1914	1·27
”	”	1·27
B	”	1·28
”	”	1·27
M	”	1·28
General average		1·24

The gradual increase of the constant may be explained by the introduction into Egypt from other countries of cane varieties, which, though giving a high yield on cultivation, contain much soluble salts. In consequence, the saline coefficient[1] of the syrup has diminished considerably, being between 15 and 16, in place of 25 to 30 as formerly in the case of the indigenous canes. However, it will be seen from this table that there is not more than 0·06 difference between the extreme limits of the constant.

By carefully determining this constant every 10 days from actual analysis, it is possible to calculate the true Brix in functions of the true sucrose and of the apparent Brix. Thus: $AB - TS = \text{Constant}\,(TB - TS)$; and in consequence:

$$TB = \frac{AB - TS}{\text{Constant}} + TS$$

One may ascertain the error that would result by assuming in the case of any period (that is to say an interval between two determinations of the true water content) a figure that is too high or too low, say by 0·02, the average variation. Given AB, 90·0; TS, 40·0; and a constant of 1·24 as found by analysis, one will have a calculated TB of $\frac{90{\cdot}0 - 40{\cdot}0}{1{\cdot}24} + 40{\cdot}0 = 80{\cdot}32$, and a true purity of 49·8.

In the same way, but taking a constant of 1·26, which is supposed to be the variation occurring since the last analysis was made, we have:

$\frac{90{\cdot}0 - 40{\cdot}0}{1{\cdot}26} + 40{\cdot}0 = 79{\cdot}70$, the true purity then being 50·1, quite a small difference.

Every chemist realizes very well that in determining the water in molasses (even when taking every precaution) it may happen when operating in duplicate that appreciable differences between the weights of the two dishes are observed. These differences may be 20 and even 30 mgrs. They are unavoidable, and falsify the result to a much greater extent than the rapid method of calculation which we here expose.

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[1] $\frac{\text{Sucrose, per cent.}}{\text{Ash, per cent.}}$

Boiling-House Methods in Hawaii.

By H. S. WALKER.

In 1920 letters were sent out by the Committee on Boiling-house methods appointed by the Hawaiian Chemists' Association requesting factory managers and chemists to report any new ideas or processes, the following topics in particular being suggested for treatment: Effect of temperature in clarification; means of removing scale from evaporator heating surface; and general methods of boiling, including boiling low-grade massecuite and the prevention of false grain.

It has been suggested that a standard system of boiling be adopted in the Territory, modified according to the equipment of individual factories, and the author submitted for criticism the following method, a slight modification of one used at the Pioneer factory for a number of years:—

Strike 1a—Start on a magma of low-grade sugar and syrup; build up and finish with syrup and remelt, no molasses being boiled in. *Strike 1b*—Start as for 1a, and finish by taking back all the molasses from 1a. *Strike 1c*—Start as for 1a, and finish by taking back all the molasses from 1b. *Strike 2*—Boil all the molasses from 1c to grain for the crystallizers.

Stated more briefly, the method consists in making every third strike from straight syrup and remelted sugar, and boiling back all the molasses twice. With syrup purities between 85 and 88°, this method works fairly well, yielding a *1c* molasses of 50 to 54° apparent purity without any attempt to boiling to fixed purities. With initial purities below 85°, strike *1c* may be omitted, and the *1b* molasses will be low enough for the crystallizers.

Then in regard to crystallizer work, several questions arise, such as the time required for complete crystallization; the effect of temperature; the effect of adding water to a massecuite on the resultant purity of the molasses; whether it is possible in any way to add water to a low-grade massecuite without raising the purity of the molasses. In other words, if on account of limited centrifugal capacity a factory cannot dry its low-grade massecuite at a higher density than 95° Brix, is there any advantage in boiling to 99° Brix, and subsequently diluting to 95°? If so, when and how should the water be added? Another point concerns the possible advantage of slow boiling of low-grades. Thus, given two massecuites of the same final Brix purity, and number of grains, if one has taken 24 hours to boil and yields a molasses which when separated hot has an apparent purity of 35°, while the other was boiled in five hours, and yields a molasses which when separated hot has an apparent purity of 42°, will there be any difference in the ultimate purity of the two molasses after two weeks in the crystallizers?

REPLIES TO THE QUESTIONNAIRE.

A number of replies were received dealing with these various points, of which the following is an abstract:—

Mr. A. FRIES (Hawaiian Sugar Co.) said in regard to the standard method of boiling proposed that it was essentially the same method as he had used at Lahaina and continued at Makaweli. There are so many points in its favour that they far outweigh the one objection that can be urged, namely the fact that three sugars of different polarizations are produced. It gives a system to the whole process of boiling which is very simple and readily taken up by the unskilled pan operator. There is less boiling than in most processes, and consequently a saving of fuel. It is well known that more sugar can be turned out under the same conditions of equipment and steam supply when more than one grade of massecuite is boiled; or, in other words, it is easier to get rid of a definite quantity of syrup if one boils the first strike to a massecuite purity of say 85°, the second of 80°, and the third of 78° than by making all strikes 78°. Re-boiling of molasses is brought to a minimum, and the molasses going to the crystallizers is therefore much less gummy than when all strikes are boiled to 78° or lower.

In regard to low-grade work, at Makaweli there are 16 crystallizers, U-shaped, holding 750 to 800 cub. ft., the stirrer making 0·3 revs. per min. In these the low-grade massecuite remains for 8 to 12 days. Whenever possible, the effort was made to maintain the density of the low-grade massecuite close to 98° Brix, though this was not possible with inferior juice. During the past year there was an improvement in the working of the low grades, and this was due to the higher density to which the massecuite was boiled; to a better grain resulting from "shock-seeding"; and to the use of the method of boiling indicated above. It was noticed that better results are obtained by boiling to a high Brix, and diluting to a lower one after several days in the crystallizers, than by directly dropping the massecuite from the pan at the lower density. Slower boiling has also contributed to a better exhaustion of the molasses.

Mr. J. W. **Donald** (Kekaha Sugar Co.) wrote that he was in favour of the two-massecuite modification of the Java process of boiling, which he characterized as a neat, simple and scientific *modus operandi*. It has the great advantage over the proposed standard method of having only one A-massecuite and one A-molasses, so that pan-men, centrifugal men, and others do not have to change their procedure from one strike to another, always working in the same way. All the molasses storage capacity required is just what is sufficient for one strike of A and one of B.

Any ordinary incrustation composed mainly of silicates and organic salts of lime and magnesia will be dissolved, or at least be left as a mere slime by caustic soda, but it must be stronger than is usually employed, and must be given sufficient time. With a solution of 12·5 to 25 per cent., in 1 to 5 days a heavy coating will be removed from every corner and crevice of the effect. Most of the scale solvents on the market under various trade names are simply anhydrous sodium carbonate, and cannot compare with caustic soda. They change the silicates to carbonates, which latter remain as firm a scale as the former, although, it is true, they can be readily removed by an additional treatment with dilute acids.

G. **Giacometti** (Olaa Sugar Co.) stated that his only departure in boiling was to grain the low-grades with white powdered sugar and after working in this way for the entire season he was satisfied that it was an improvement. Grain is certainly more even, and when used for "seed" in boiling the commercial (96°) grades, its influence is still more apparent. Further, for reasons that are yet not understood, it seems that sugars boiled in this way are free from "conglomerate." A few hours before opening a crystallizer, the massecuite is diluted with a few gallons of cold water, which helps considerably in the centrifugals, while no effect can be traced on the purity of the final molasses.

Mr. H. D. **Beveridge** (Onomea Sugar Co.), in referring to the author's work on the temperature of clarification,[1] said that he had obtained the best results at 210 to 220° F. (99 to 104° C.), lower temperatures apparently having as their result a large deposit in the pre-evaporator and first cell of the evaporator. He has not tried a temperature above 220° F. (104° C.) for fear of destruction of sucrose through overheating. In removing incrustation the evaporators are cleaned in the usual way, viz., by boiling out with caustic soda at atmospheric pressure, finally cleaning out with scrapers and brushes.

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[1] *I.S.J.*, 1922, 154.

Regarding the proposed standard method, he remarked that it has the advantage of starting with fresh molasses every third strike, which is desirable. A method practised at Honomu for several years was as follows: Two pans were started on magma of low-grade sugar and syrup, and finished with syrup and re-melt, obtaining a massecuite of 82 to 86° purity, sugar of 97·8 to 98·2° polarization, and molasses of 66 to 70° apparent purity. One and a half pans were dried off in the centrifugals, and all the molasses obtained taken on the half pan and struck, obtaining a massecuite of 78 to 80° purity, sugar of 96 to 96·5° polarization, and molasses of 52 to 55° apparent purity, which molasses was boiled to the crystallizers. With evaporator syrup of 86 to 88° purity, this method gave approximately 70 per cent. of the 98° sugar, the result being the 96° grade.

Crystallization of massecuite is practically complete in the crystallizers when the atmospheric temperature is reached, which at Onomea is from four to six days, after which only a slight drop is noticed. The gain in boiling a massecuite to 98° Brix and diluting to 95° for the purpose of purging, as compared with boiling the massecuite to 95° Brix and purging without dilution, is very apparent. The 98° Brix massecuite has crystallized further than the 95° one, and without the addition of water the purging qualities of the two would be nearly the same, but with dilution the 98° Brix massecuite purges more freely than the other.

Mr. R. J. **Richmond** (Wailuku Sugar Co.) mentioned that he usually heats his juices to 214°F. (101°C.), having found that at lower temperatures the clarification is not as good. Continuous settlers are used, and the juice is left over-night, a loss of 2 to 5° purity being noticed in the morning. For cleaning evaporator effects, he uses only soured molasses with an occasional boiling out with hydrochloric acid about once a month, but on Sundays the tubes are cleaned with scrapers of brass wire fixed around rubber rings on wooden rods. Soda ash has given good results on his scale, but its use had to be abandoned owing to cost.

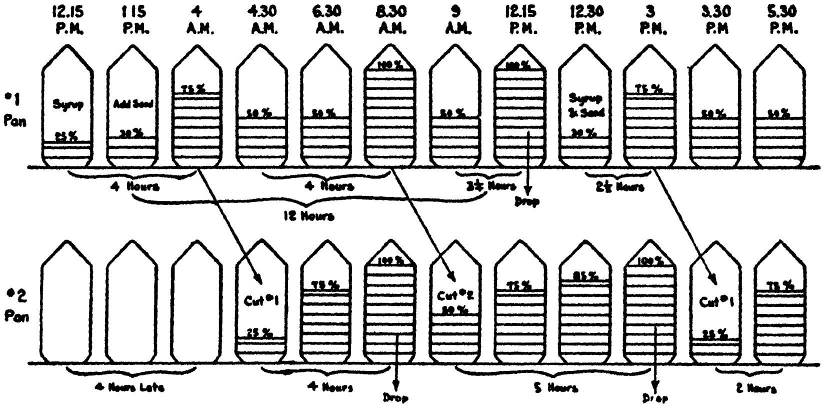
Mr. R. C. **Pitcairn** (Wailuku Sugar Co.) replied that in low grade boiling all the pans were started on fine sugar dust, using 2 lbs. for every 1000 cub. ft. of finished product, and it was found that the resultant sugar was more uniform in size and easier purged, giving a better "seed" for the No. 1 pans. In regard to false grain, the causes of its formation are too small a number of original grain, an expansion of the massecuite due to heat, water, or an overfeed of molasses separating the grain already present to such an extent that room is given for the new formation to occur. For its prevention, sufficient grain must be formed; and then there must be careful pan work in regard to the feeding of the molasses and water, good circulation, and careful control of the temperature, especially in the later stages. There is an advantage in boiling to 99° Brix instead of 95°, in that this procedure exhausts the mother-liquor in the pan, and deposits that great portion of the sucrose on the existing grain, leaving less inter-granular sucrose to be deposited by the contraction taking place in cooling, the possibility of the formation of false grain being diminished, and the time of economical recovery being shortened.

Mr. F. H. **Hadfield** (Hilo Sugar Co.) gave an outline of his general method of boiling No. 1 massecuite, the time taken and the amount drawn into the pans being shown in the sketch reproduced herewith, this method being as follows: Begin No. 1 pan with syrup and boil to string-proof about 25 per cent. of pan; take in seed; build up to 75 per cent.; first cut down to 50 per cent. of pan; build up to 100 per cent; second cut down to 50 per cent. of pan; build up to 100 per cent.; finish off with molasses and drop taking 12 hours in all. Begin No. 2 pan by taking first cut from No. 1 pan of 25 per cent.; build up to 100 per cent.; finish off with molasses; drop; take in second cut of 50 per cent. from No. 1 pan, finish off with molasses and drop. In boiling the No. 2 massecuite, the procedure is to take in 25 per cent. syrup of 86-87° purity and molasses of 50 purity; boil to grain, add about 5 lbs. of carbonate of soda; build up slowly till 90 per cent. of pan; and drop at about 95–96° Brix.

AUTHOR'S COMMENTS ON THE REPLIES RECEIVED.

Taking up the individual topics on which discussion was invited, the following remarks may be made:

Clarification.—Three factories after heating their juices to a lower temperature than ordinarily reported that the clarification was not as good as at 212° F. The author's experience this year was that just as clear juices can be obtained at 180° F (82° C.) as at 212° F., but that as a rule a considerably longer time is required for settling at the lower temperature.



Evaporator Scale.—It would seem that with the type of scale obtained in the Territory, caustic soda is much more efficient than carbonate. Good results are obtained by using 50 per cent. caustic solution, but a scheme which may prove practicable is to spray the tubes with a little of the 50 per cent. solution, and turn steam into the calandrias, thus concentrating the chemical. Another method which has worked very well on the small scale is to boil for half an hour at atmospheric pressure with 10 per cent. caustic solution, drain off the liquor to a tank, and, without rinsing, turn the steam into the calandria for half an hour. This concentrates the soda, cracks off most of the incrustation; and, provided that a thorough boiling with water follows, lessens the amount of acid necessary for the final treatment.

Boiling Methods.—It would seem that the choice of methods is narrowed down to two, namely the one proposed, and that generally used at the present time in Hawaii, in which only one purity of first massecuite is made, taking back sufficient molasses into each strike to lower its purity to about 76 to 87°, though according to published reports this method is no longer used to any great extent in any other cane sugar country. It has the advantage of apparent simplicity as only one grade of massecuite is made, and of uniformity, for the same reason.

On the other hand, more molasses is kept in circulation, and since the average purity of the first massecuite is lower than where it is reduced in three stages, the average yield of sugar per strike is lower, which necessarily means more strikes, more pan capacity, and more steam for a given weight of sugar produced.

It may be urged that an objection to the new method is that three grades of sugar are made; but the average variation in the polarization was found to be as follows as the average of about four weeks' working: *1A*, 97·5; *1B*, 95·1, and *1C*, 94·8. Other average figures for four months' run are: *1A*, 97·6; *1B*, 96·9; and *1C*, 96·1. When making 96° sugar, the variation in polarization can easily be "smoothed out" if necessary by painting the *1A* strikes with *1C* molasses to reduce the polarization, and after doing this an average of 32 strikes showed the following polarizations: *1A*, 96·8; *1B*, 95·7; and *1C*, 95·4. Technical men from the Crockett Refinery saw no objection to this mode of working from their standpoint, as the grain was the same in each strike. VON STIETZ[1] recently described a boiling method used in Java, in which three strikes at 85–90, 70–75, and 60° apparent purity were made, a somewhat similar method having been used at one time at Ewa plantation, T.H.; and were manufacturers in the T.H. permitted to make a 98 polarization sugar, such a method would seem to be the ideal one, as it minimizes the amount of molasses returned; and, graining in a purer medium, furnishes a better and larger seed grain for the No. 1 sugars.

Low Grade Boiling.—The feature of the year is the very general adoption of the use of powdered sugar for forming grain, and those who have tried it are almost without exception in favour of it. The method is used at Crockett Refinery for graining all their white sugar as well as their low-grade strikes, about a quart of powdered sugar being used for a 1700 cu. ft. strike. At the sugar-house mentioned they do not consider that the sugar introduced is really the grain on which the strike is built, but believe the sudden shock, together with the spreading of a few crystals through an already supersaturated solution, causes crystallization to take place. The amount of sugar taken in for "shock seeding," or the size of grain used, does not make much difference, the important point being the density of the syrup at the time it is seeded.

At the Spreckels beet sugar factory a very rapid method for graining first sugars has been worked out. A small single-effect evaporator furnishing vapour to the heaters concentrates a portion of the syrup to about 80° Brix. This is kept in separate storage tanks. When a pan is started up, they draw in a charge of this practically saturated syrup, turn on the steam, give it a "shot" of white sugar and go on boiling; the grain appears immediately.

We have been trying the powdered sugar graining method at Pioneer off and on during the past season, the majority of our low-grade strikes being thus grained. Our sugar boilers are not enthusiastic over it, and are not at all sure that the grain comes any quicker or evener with than without its use. A possible explanation of our inability to detect any improvement from the use of powdered sugar is that we have already been "shock seeding" without knowing it. The majority of our strikes are grained by boiling to proof and dropping into an insulated tank. As there is always a good deal of old grain left in the bottom of the tank, this, together with the agitation brought about by dropping, may in itself be enough to induce crystallization. On the other hand, many of our strikes were grained in the pan, with and without powdered sugar, and we have never been able to detect any consistent difference in results. We grain by boiling to proof and letting stand. Grain first appears in about half an hour, but takes about two hours standing to grow sufficiently to start boiling. The amount of grain produced varies with the Brix, purity and stickiness of the boiled-down molasses, and the variations from these causes are greater than from the presence or absence of powdered sugar.

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[1] *I.S.J.*, 1920, 650.

Time for Complete Crystallization.—This seems to vary in different factories. Tests made at Onomea and at Hilo Sugar Co. indicate that crystallization is practically finished in from 6 to 8 days. At Pioneer we have held over a number of crystallizers and made separations at regular intervals as we did last year, and invariably find a drop in the purity of molasses of from 1 to 2° between the 14th and the 28th day. After the first month the drop is very slight, probably less than one point on standing four months longer.

Probably the nature of the impurities in the molasses has a great deal to do with the duration of crystallization. Molasses around Hilo is generally considered to be easier to reduce to a low purity than that from other places; and if the crystallization takes place easier, it is logical to suppose that it will be completed sooner. Another reason for the difference may be that some factories do more of their crystallization in the pan than do others. Due to our small low-grade pan capacity, many of our strikes have to be boiled in less than 6 hours. The average of 88 separations on hot massecuite leaving the pan last year at Pioneer was:

	BRIX		APPARENT PURITY
Massecuite	97·0	..	54·0
Molasses	95·7	..	44·3

Some factories are able by long boiling to get the mother liquor in a low-grade strike down to less than 40° apparent purity, which would tend to shorten the time for after-crystallization.

Effect of Adding Water.—We have never been able to add water to a low-grade massecuite (and we have tried every known method), without raising the ultimate purity of its molasses. Unless we accept the now disproven theory that concentration to a higher than the usual factor Brix does not cause more sugar to crystallize out, it is obvious that reducing this Brix in any way must dissolve sugar. We have, indeed, added water in small amounts to a massecuite which was still cooling, and obtained a continued drop in molasses purity, but similar massecuites without the water dropped still lower.

Experimental work on a small scale indicates that it is possible to separate the molasses from a highly-concentrated massecuite, add a small amount of water to it, mix with sugar and separate again with very little if any increase in purity. This can be explained only on the ground that the molasses first separated is still in a supersaturated condition. It may be that a certain degree of supersaturation is necessary to force crystallization and that a very heavily concentrated molasses never reaches the point of exact saturation. Such a condition suggests that it might be possible to mix a little water with a massecuite in such a way that some of it at least would be used up in reducing the supersaturation of the molasses and would not dissolve sugar. Our experiments along this line lead me to believe that if a massecuite is to be dried at 95° Brix there probably is a practical advantage in boiling to a higher Brix and diluting to 95°, but the gain is in time only. If two similar massecuites, one of 95°, the other of 98° Brix, were crystallized for six months, then the 98° reduced to 95° with water, the molasses purities from each should be the same. Similarly, a prolonged boiling undoubtedly shortens the period required for practical crystallization, though ultimately two massecuites of the same Brix and composition must yield exactly the same purity molasses.

Mr. B. B. HENDERSON made some very careful tests on the rise in purity caused by adding water in our crystallizers. Water was added in varying amounts, taking from 6 to 24 hours to add one barrel to a 700 cu. ft. crystallizer. His results show the following figures:—

Per cent water	2·6	2·5	2·2	1·8	1·6
Original purity of separated molasses	29·5	30·1	31·6	30·5	32 0
Purity after adding water	32·5	31·8	33·0	32·4	33·1
Increase in purity	3·0	1·7	1·4	1·9	1·1
Increase for each per cent. water added	1·15	0·68	0·64	1 06	0·69
Hours in crystallizer after adding water before separating	6	12	6	48	42

He concludes that, very roughly, one per cent. of water increases the molasses purity by one point.

Viscosity of Molasses.—Mr. HENDERSON has also made a large number of tests on the viscosity of molasses, and the effect of varying the Brix and the temperature.

He made use of the falling sphere method, using the length of time taken by a steel ball to fall through a definite depth of molasses as a measure of viscosity.[1] The method was found very difficult to manipulate so as to get concordant results; but averaging a number of tests he reports that, working with a molasses of 93·6° Brix and 32·4° apparent purity, heating it 4° within the limits of 27° and 43° C., reduces its viscosity to about the same extent as adding 1 per cent of water. One per cent. of water on the molasses in a massecuite is equivalent to about 0·7 per cent. water on the massecuite.

The average of a good many tests here has shown us that heating a massecuite 5° C. raises the purity of molasses about 1 point. Heating it 4° would raise the purity of the molasses 0·8, while adding 0·7 per cent. water would raise it 0·7 point, so from this calculation there is very little choice between water and heat, either as regards their advantages or disadvantages.

As stated, these are all very rough calculations, and should only be regarded as a first attempt to reduce to figures what has previously been left largely to guesswork. It is evident that a great deal more data are required from different factories before one can really know much about the subject.

It is well-known by analysts,[2] that, in determining sulphuric acid in alkali sulphates by precipitation as barium sulphate, some of the alkali sulphate and also a little of the barium chloride may be withdrawn from solution and carried down with the precipitate. Further, if nitric acid or nitrates be present in the liquid under treatment, these also will generally be found in the barium sulphate. The degree to which this entrainment of soluble matter may occur depends above all on the concentration of the liquid, but also on the temperature and the acidity, each of which factors are of influence in controlling the amount of dissociation of the ions. The only way in which a precipitate free from contamination can be obtained is to work with solutions in which almost all the molecules are dissociated; but this does not necessarily involve any considerable addition of water. One should so operate that the alkali sulphate solution and the barium chloride solution are simultaneously dropped into boiling water in a beaker, so regulating the dilution and rate of flow of the re-acting solutions that approximately equivalent quantities are added. In this way, not only is pure barium sulphate obtained, but the precipitate comes down in a coarse form that readily subsides and can easily be filtered off and washed. This method of operating can advantageously be applied also to the precipitation of calcium as oxalate.

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[1] *Cf. I.S.J.*, 1922, 83.

[2] F. HAHN, *Chemiker Zeitung*, 1922, 862.

A Study of the "Factor of Safety" of Sugars, with Special Reference to Methods required for the Manufacture of Sugar conforming thereto.

By WM. L. OWEN,
Research Bacteriologist, Louisiana Sugar Experiment Station.

(*Continued from page 586.*)

The last table given in the previous instalment of this paper shows the analysis of the sugars made from the three molasses; also the analysis of the two sugars made from standard granulated sugar. These were made into a magma with Louisiana and Cuban blackstrap and purged in the centrifugal. Of these sugars only No. 404 conforms to the factor of safety. The analysis of the molasses coming off the sugar is given in the following table:—

TABLE VI.

Analyses of Molasses from Sugars.

SAMPLE.	Refractometer Reading.	Corrected Brix.	Factor.	S.P.	I.R.	S.C.	R.S. S.S.	R.S. C.C.	Per cent. R.S.	Purity.	Purity over Syrup.
No. 404	1·4865	79·02	0·386	38·8	2·4 X 8	45·68	7·5/500	14·5	22·9	57·8	58·06
No. 1202	1·4875	79·50	0·334	28 8	2·5 X 8	38·72	7·5/500	14·0	23·8	48·7	58·7
No. 1207	1·488	79·57	0·339	29·2	—2·6 X 8	39·85	7·5/500	14·5	22·0	50·0	64·6

TABLE VII.

Results of 1 Month's Incubation of Laboratory-made Sugars.

Sample.	Moisture per cent.	S.P.	I.R.	S.C.	R.S. S.S.	R.S. C.C.	Per cent.	Factor.	S.C., dry basis.
No. 1202— Inoculated No. 75	5·0	80·8	— 6·7 x 4	85·70	9/200	19·5	5·7	0·349	90·21
No. 1202— Inoculated No. 75 (2)	4·4	82·8	— 6·8 x 4	87·23	9/200	20·4	5·4	0·344	91·3
No. 1202— Inoculated *A. niger*	4·4	81·8	— 6·6 x 4	85·81	9/200	19·7	5·6	0·310	89·7
No. 1202— Control	4·3	82·6	— 6·7 x 4	86·77	9/200	21·4	5·1	0·325	90·6
No. 1207 Inoculated *A. niger*	2·9	88·0	— 6·9 x 4	91·63	9/200	27·7	4·01	0·346	94·36
No. 1207 Inoculated No. 75	3·3	87·0	6·7 x 4	90·17	9/200	27·9	3·9	0·335	93 24
No. 1207— Control	3·15	88·2	6·6 x 4	90·76	9/200	27·9	3·9	0·346	93·71

No. 404— Inoculated *A. niger*	6·2	77·0	5·7 x 4	80·79	9/ 200	19·6	5·6	0·322	86·13
No. 404— Inoculated No. 75	6·9	76·0	6·0	79·58	9/ 200	19·0	5·84	0·337	85·47
No. 404— Control	6·4	77·2	6·1 x 4	79·47	8/ 200	18·0	6·9	0·302	84·7

In the above table is given the results of a one month's storage of this lot of laboratory-made sugar. It will be noted from this table that practically no deterioration occurred in the sugar during the storage period. Now if we compare the densities of the molasses from the last lot of sugars with those of the preceding experiments we will find the latter to be higher. The densities are as follows:—

No. 1.	74·44	No. 2.	77·75	No. 3.	79·02 79·50 79·57

While the higher densities of the films of molasses around the third lot of sugars are largely responsible for their better keeping qualities, it is not to be assumed that the rate of deterioration is governed by this condition alone. Since the action of invertase is slowed down by the accumulation of the products of its action, we might expect the inverting action of mould fungi to be slower in low purity than in high purity molasses films even when the density is the same. The validity of the "factor of safety," therefore, owes its reliability to the fact that it connotes a molasses film, unsuited either by density or its non-sucrose to sucrose ratio, for the development of the deteriorative type of mould fungi.

We have already referred to the fact that the molasses from these sugars did not deteriorate within the period of our observation. This is not to be interpreted to mean that these molasses would not deteriorate during a long period of storage. It is an indication, however, of the influence of surface exposure upon the deterioration of a molasses, for in the foregoing experiments it was under observation in shallow layers as a film around the sugar crystals where there was a large surface exposure, and in this experiment in deeper layers when observed in its liquid form. Since the mould fungi are largely aërobic they are more active where there is an abundant supply of air, and this is just the condition supplied by molasses films surrounding sugar crystals. **Browne** has shown that cane molasses do undergo a rather rapid deterioration while in storage, and that the loss in sucrose may be considerable during a period of several years. In order to test the effect of surface exposure upon the deterioration of molasses, a sample of molasses was used to coat some washed sand. The sand used was obtained by screening white river sand, and collecting all that was retained by a soil sieve of $\frac{1}{16}$ in. mesh. The sand was washed with acid and frequently boiled with water and filtered. After drying thoroughly the sand was coated in the laboratory centrifugal with a molasses of the following composition:—

Brix (refractometer)	74·17	Sucrose (Clerget)	44·58
Single polarization	40·00	Reducing sugars	1·74

The analysis of the coated sand was as follows:—

Single polarization	1·3	Reducing sugars	0·55
Sucrose (Clerget)	1·47	Moisture	2·6

The sand was then placed in flasks, inoculated with mould cultures, and the flasks tightly stoppered with rubber stoppers and placed in the incubator. At the end of 1 month the analysis was as follows:—

Table VIII.

I Month's Storage Laboratory-made Cuban and Louisiana Sugars.

Sample.	Moisture per cent.	S.P.	I R.	S.C.˙	S.S.	C.C.	Per cent.	Dry Basis S.C.	Factor.
Cuban— Inoculated *A. niger*	2·4	90·0	6·5	92·17	20/ 200	17·0	2·9	94·4	·306
Cuban Control	2·6	90·8	—6·8	93·82	20/ 200	17·6	2·84	96·32	·420
Cuban— Inoculated No. 75	2·6	89·76	6·5	91·88	20/ 200	17·8	—	94·43	·324
Louisiana— Inoculated No. 75	1·75	93·4	13·4 x 2	95·5	20/ 200	19·2	2·6	—	·388

Showing the results of one month's incubation of inoculated molasses coated on sand:—

SAMPLE.	SUCROSE (CLERGET).	REDUCING SUGARS, Per cent.	MOISTURE, Per cent.
Inoc. *A. niger*	—	1·04	2·62
,, ,,	—	1·04	2·85
No. 75	—	1·23	2·87

The analysis of the molasses after one month's incubation was as follows:—

Table IX.

Results of 1 Month's Incubation of Molasses used in Sand Sugar.

SAMPLE.	Refractometer.	Corrected Brix.	S.P.	I.R.	S.C.	R.S. S.S.	R.S. C.C.	Per cent
Inoculated, *A. niger*	1·472	72·89	10·1 x 4 40·4	— 2 x 8	44·21	7·5/ 300	11·5	17·4
Inoculated, No. 75	1·475	74·09	39·6	— 2·1 x 8	44·28	7·5/ 300	11·5	17·4
No. 75	1·473	73·37	39·6	2·1 x 8	44·28	7·5/ 300	11·5	17·4
Control	1·478	74·17	10 x 4 40	— 2·6 x 8	44·58	7·5/ 300	—	17·4

From the above table it will be seen that practically no deterioration took place in the molasses, while all of the sucrose had been destroyed in the same molasses when in the form of a film around the sand crystals. This explains why small grain sugars are more susceptible to deterioration than large grain sugars even when the molasses films in the two cases are identical in composition. It is of significance to note that no deterioration occurred in any of the preceding experiments where the sugars conformed to the "factor of safety." In practice, however, many sugars are known to deteriorate even when the factor of safety is lower than 0·333. It is quite true that a storage period of only one month may not be an infallible criterion of the behaviour of a sugar during a prolonged storage period. However, we have found that as a rule a storage period of one month is a reliable criterion of the keeping quality in sealed containers for a prolonged period of storage. The reliability of the "the factor of safety" on sugars that have never absorbed any atmospheric moisture may be due to the fact that absorbed moisture may play a greater part in sugar deterioration than the moisture contained in the molasses. This would undoubtedly be true if the absorbed moisture is not thoroughly incorporated into the molasses film, and if it existed in the form of an outer periphery of diluted molasses which would be more favourable to the growth of the micro-organisms than the interior of the film. If absorbed moisture is not readily incorporated into the film, the "factor of safety" would not have the same validity when applied to two sugars, one of which had a homogeneous film of molasses, and the other a film with a diluted periphery due to absorbed moisture. This conception of the film makes a study of sugars, whose films are known, of greater value than the mere observation of sugars whose films are of unknown origin. This preliminary study therefore suggests the following facts for consideration, viz.:—

(1) The validity of the "factor of safety" as a criterion of the keeping quality of sugars is due to the fact that it denotes a molasses film surrounding the sugar crystals unsuitable for the growth of micro-organisms capable of causing its deterioration.

(2) The value of the "factor of safety" varies with the type of infection present, the purity of the molasses film, and also the surface distribution, i.e., the size of the crystals.

(3) It is also probable that the value of the "factor of safety" depends upon whether the moisture of the film is homogeneously incorporated therein or existing as an outer zone of dilute molasses.

(4) For raw sugars to conform to the "factor of safety" they must crystallize in a magma of such purity that their molasses films will be unsuitable, either in density or composition, for the growth of micro-organisms. To manufacture such sugars, a good clarification of the juice is required, so that the proper exhaustion of the molasses may be secured.

It cannot, of course, be claimed that sugars made in the laboratory represent the same conditions of manufacture as those made in a factory. But although the exhaustion in purity of the molasses cannot be carried as far in the laboratory as in the factory, yet our purpose is served by learning what the composition of a molasses film in a sugar must be to prevent deterioration. Therefore, it is immaterial to our purpose whether we are able to exhaust our syrups as rapidly as is effected in a factory. Our principal purpose has been to determine the manufacturing methods that result in good keeping sugars. The "factor of safety" of the molasses made in these experiments is subject to the error due to the presence of fine grain, hence the "factors" for these sugars are probably too high. The fact that the refractometer solids have been used for calculating the "factor" also contributes to a higher factor than when the solids are obtained by the spindle, as is the practice both in Louisiana and the tropics.

In considering the results on the storage of the molasses samples, it must be remembered that the conditions were less favourable in our experiments for the development of the micro-organisms causing their deterioration, than they are under natural conditions of storage. Just as we have seen that the molasses films around sugar crystals are more susceptible of deterioration than the molasses in deep layers, so for the same reason molasses in small tightly stoppered flasks would probably be less susceptible than molasses in large open or enclosed tanks. We intend this only as a comparison between the behaviour in storage of molasses in films and in deep layers, and not as an example of the deterioration of molasses in practice.

The writer is indebted to Assistant-Director W. G. TAGGART for many helpful suggestions in connexion with the above investigations, and also to the PENICK & FORD Co., LTD., for kindly furnishing the samples of syrup and molasses used in the experiments.

Recent Work in Cane Agriculture.

SUGAR CANE PESTS AND DISEASES IN TRINIDAD. *C. B. Williams. Bulletin of the Agricultural Department of Trinidad and Tobago. Vol. XIX, No. 3, 1921.*

The present reference will be confined to the observations on mosaic disease, some of which are of great interest.

History and present situation.—When first noted in Trinidad this disease was met with in farmer's plots near to the experiment station at St. Augustine's, and in about 40 isolated localities to which diseased cuttings had been inadvertently distributed. Recently, the disease has been noted on an estate where, judging by the stage to which the infection has spread, it appears probable that it could not have been passed on from St. Augustine's. For years, on this estate, seedling canes have been received from Barbados, although mosaic disease has only been recognized in that island for the past year or two. This estate may be regarded as possibly a second and independent source of infection in Trinidad. Control was started in 1920, and £500 was granted by the Legislature as compensation for stools destroyed; and some 40,000 were thus dealt with. But the spread was so rapid in the wet weather that the disease soon got beyond control, and it was obvious that measures on a wider scale were necessary. Accordingly, a new campaign was started in 1921 and £3000 was voted for the purpose.

Effect on the cane plant.—The critical points of distinction are (1) pale markings always elongated, though in certain varieties (D 1753) the markings are square or rectangular for some unknown reason. (2) The pale area is green to almost white and is caused by there being less green and not (as in other leaf spots) more yellow or brown. (3) The markings are always more distinct in young leaves just unrolled. It is usually stated that, once a new leaf is unfolded and healthy, it will not be attacked, and it is the fact that older leaves may be perfectly healthy while the young ones are affected, but the reverse is never the case. It is also stated that the dead leaves never become brown, but in a very few varieties brown or yellow specks appear, and these increase in distinctness till the death of the leaf. This variation is specially noticeable in D 3953 and D 6540 (*sic*). BRANDES has also found this to be the case in a few varieties in the United States. (4) The mottling is always more distinct in otherwise healthy plants. Thus, manuring brings the marks out more clearly because of the darkening of the green parts of the leaf.

The visible effect varies considerably with the kind of cane attacked. The results of an experiment to bring this out are given in a Table, and it is seen that, after four months' growth, T 491 and T 67 showed very little difference between the healthy and diseased plants. Among the varieties tested the decrease in size caused by the disease varied from 3 to 50 per cent. The deaths noted in this test among the sets planted were 13 out of 87 in the diseased cuttings and only 2 out of 79 in the healthy.

Other plants infected.—Thus far only maize and one wild grass have been met with attacked by sugar mosaic. BRANDES in the United States also found it on Guinea corn, but this crop is very rare in Trinidad. The disease in maize is also not serious in Trinidad because there are no plants growing during three months of the year, and the passing on of the infection from crop to crop is thus impossible.

Natural spread of the disease.—In Trinidad there is practically none in the dry weather. Thus, from March to July only three were added to 68 affected plants, and, in another case, only one to 14. During August and September, on the other hand, the spread of the disease is extremely rapid and, after a comparative cessation, again in November. This connexion with moisture has been noted in other directions, e.g.) in the Couva district mosaic was seen to spread along the banks of a small river. Another striking instance was seen in a stretch of canes passing down a long slope and across a piece of low, flat, moist land at the base. The whole area was uniformly infected at the start, but at the end of the season the low piece was found to be much more severely attacked.

There appears to be no doubt that insects are actual carriers of mosaic. **Brandes** has definitely proved this to be the case in the United States with maize aphis (*Aphis maidis*) and, less conclusively, Smythe in Porto Rico has named a cane leaf scale (Pulvinaria), the yellow corn aphis (*Sipha flava*), a mealy bug (Pseudococcus), and the crane fly. Experiments in Trinidad have led to no such result with the frog-hopper, the corn leaf hopper, the cane leaf hopper and a cane membracid. The only other cane insect considered capable of transmitting the infection is the mealy bug, and experiments are being conducted with it.

Owing to an outbreak among maize plants sown in the holes from which diseased canes had been removed, it was suggested that the disease might be passed through the soil. An experiment was therefore carried out at St. Augustine's with 50 cane sets and 50 maize seeds, planted on a piece from which cane plants had been dug seriously infected with mosaic. And a similar plot was laid down on sound ground as a control. None of the plants on either plot were attacked, from which it may be concluded that there is no danger of infection through the soil.

The distribution (and spread) of mosaic in the plant.—Work on this aspect of the question appears to have led to interesting results. It is generally held that all cuttings from a diseased plant will reproduce the mosaic disease. This is practically true of plants showing the disease in all its stalks and especially when raised from diseased cuttings. But, in secondary infection, it appears that the spread of the disease to all parts takes place comparatively slowly. It takes a considerable time for the infection to pass from the leaf to the ground, and the passage from one stalk to another through the underground connecting parts takes still longer. A number of experiments are described which leave no doubt that the above statement is correct; and it is claimed that this fact may have an important bearing on the eradication of the disease in places where the necessary attention can be given to the matter. Thus, in cases of recent infection, it may be possible to save the clump by at once cutting all the stalks to the ground, and experiments have been started with the idea of so poisoning the affected stalk or stalks that they will be unable to grow any further and send out fresh shoots. If these experiments succeed, it should be possible to keep the disease under control, towards the end of the year, without the wasteful and costly removal of all the affected clumps.

SUIKERVORMING EN RIJPING BIJ HET SUIKERRIET (SUGAR FORMATION AND RIPENING OF THE CANE). *J. Kuyper. Mededeelingen van het Proefstation de Java-suikerindustrie. 1922, No. 5.*

This long paper of 127 pages deals with certain physiological considerations on sugar formation, which are directly connected with modes of cultivation, and the methods adopted to determine the moment of ripening and the effect of various external conditions upon it. The formation of organic matter in the cane is primarily due to the energy of light and the amount of chlorophyll-bearing tissue exposed to it. A variety with deep green leaves will have the advantage over one with light green leaves, and healthy canes over such as are affected, for instance, by yellow stripe, because of the diminution of chlorophyll in the latter. Similarly, kinds of cane with leaves curving broadly expose more of their surface to the light, and, if these leaves are wide, there is more surface to expose. The stand of plants should be so arranged that the whole area is completely covered by a uniform sheet of green, there being no gaps of any kind. Tying up the canes, although of advantage in preventing lodging, places the plants at a disadvantage as regards the formation of organic matter, and consequently of sugar. Other things being equal, a great weight of cane usually goes with a lower percentage of sugar in the juice, but in a good climatic year both weight and sugar are increased because of superior ripening conditions. Early crops are almost always less liable to risks than later ones.

Ripening is estimated by preliminary analyses of the juice. Estimations of the weight of canes for this purpose have hitherto led to no useful results and this method is unlikely ever to supersede the analysis of the juice. The question of sampling is gone into very thoroughly. The requirements in the field are that there should be only one kind of cane, derived from the same planting material and planted at the same time; the differences of time in planting the canes should not exceed 15-20 days at the outside, as a month's difference introduces serious discrepancies. Added to this, the variations in the character of the soil should not be great, and the area being tested should not exceed ten bouws (17-18 acres) at the most, and should if possible be less. It is best to mark the clumps to be sampled at a considerable time before the canes are cut for analysis, so that the latter operation becomes more or less a matter of routine. In case of a casualty, the sampling of an adjoining clump will make little or no difference. All selection at the time of cutting should be rigidly excluded as introducing the personal factor excepting in the case of disease or lodged canes. Diagonal lines across the field are considered the best.

The mode of ripening in different varieties is discussed, and it is pointed out that great differences occur in this, as well as in the various plantations themselves. The author attempts to group these latter according to conditions, primarily of climate, selecting Remboen and Gempelkrep for more detailed study. Among the varieties, 247B and POJ 100 receive special attention because of their wide distribution and inherent differences in many respects. In analysing the samples, the author strongly advocates cutting the stems into three sections, lower, middle and upper. Dividing the canes into ten pieces gives beautiful results, but is generally impracticable, while cutting them into two introduces various difficulties in judging the results. He devotes a section to discussing the WS, Brix, and RQ of the juice (presumably the recoverable sugar, Brix and quotient of purity), and shows that in effect a strong east (dry) monsoon tends to a uniform development of the juice in these directions in the different parts of the cane. The RQ in general shows the greatest variations, and is thus most useful in determining irregularities in the ripening. Since the glucose factor undergoes changes corresponding with the ordinary juice figures, he doubts the need for its introduction. In all cases it is necessary to have a knowledge of the special peculiarities of the variety dealt with and of the locality in which it is grown. There are a great number of other points in this interesting paper but those mentioned above will give a general idea of its scope and character.

Recent Work in Cane Agriculture.

THE CULTIVATION AND MANURING OF SUGAR CANE. *R. S. Cunliffe. Chilean Nitrate Committee, Trinidad.*

This pamphlet of 60 pages contains much that is of interest to sugar cane planters, especially in the West Indies. The prevailing soils are carefully described and the principles of their treatment laid down. Rotation of crops, methods of planting, the cultivation of plant canes and ratoons, are dealt with on general lines; the principles are clearly enounced and much sound advice is given. Experiments are described with regard to planting in the square and oblong, selection of planting material, planting on the flat and on banked land, with the relative costs of the two latter methods. The cost and efficiency is also discussed of implemental as against hand labour under West Indian conditions, the recent experiments conducted in Trinidad being summarized. Shorter sections are devoted to irrigation and drainage, cane varieties and insect pests, and the pamphlet has at its end a statement of the sugar crops of the world from 1918 to 1921.

The section on artificial manures is carefully worked out, and the discussion on pen manure, green dressings, commercial fertilizers and the methods of calculating the required quantities per acre are well worth reading. This concluding portion then proceeds to describe a number of experiments conducted by the Chilean Nitrate Committee or at their instigation in various countries. Some excellent and little known illustrations are added and enliven the matter, those from Venezuela being of special interest. A well selected series shows graphically the difference between the old and laborious methods and up-to-date labour-saving machinery at work.

SUGAR CANE EXPERIMENTS IN THE LEEWARD ISLANDS. *Report on Experiments with varieties of sugar cane conducted in Antigua, St. Kitts-Nevis and Montserrat in the season 1920-21. Barbados, 1922.*

The experiments were conducted on the usual lines. The plots are situated on the fields of various estates in the chief sugar-producing areas of the Colony, and the treatment is identical with that on the fields around. Each plot is one fortieth of an acre in extent and frequent repetitions are made of each. The canes are planted in single rows across the field, as this method is claimed to give more reliable results than by planting in rectangular blocks. In general the number of clumps to the acre varies from 2000 to 2200. Copies of the results are sent to the managers of the estates where the experiments are conducted, and complete records are filed in the offices of the agricultural department for inspection. At the end of each season the results of the year's experiments are reported by the agricultural officer in each Presidency at a meeting of the local agricultural society and the history of the best ten for the season is gone into.

The following varieties have been eliminated during the year:—B 3289, B 3675, B 4574, B 4578, B 6204, B 7169, D 74, Uba, and A 67. As many as 16 were added instead, including seven Barbados seedlings, M 998, five Antigua seedlings, Uba from Jamaica, and Striped and White Tanna. Only these varieties are botanically described, the discarded ones being noted by an asterisk, and the reader is referred to the previous reports for the characters of the rest, a considerable saving in printing. The following details are extracted regarding the first ten for the year in Antigua (as regards the production of juice per acre). In order to judge of the changes which have taken place in this order of merit, their position in the general list is given for the previous year in brackets:—Plant canes: B H 10 (12) (11), B 6308 (1), B 4596 (4), Uba Jamaica (new), B 6388 (7), B 6450 (20), B 3922 (2), Ba 6032 (12), A 410 (new), White Transparent (31).

Ratoons: B H 10 (12) (4), A 1270 (new), B 6450 (30), B 3922 (1), W No. 2 (21), A 1700 (new), B 6308 (9), A 1295 (new), Sealy Seedling (16), B 6388 (6). It is noteworthy that some of the Antigua seedlings have good ratooning powers.

The position of Uba in Antigua is interesting. In 1916-17 it headed the list of ratoons for tons of cane and pounds of juice per acre, but in its two trials as plant cane during the previous 10 years it only attained to the position of 31st, and is discarded. Uba from Jamaica has now taken its place and, as plant cane, has been placed fourth in the list of 48 varieties. It will be interesting to note its position as a ratoon next year. B.H. 10 (12) has taken first place this year as plant cane and as ratoon in Antigua: it is also first in both plant cane and ratoon in St. Kitts, and as plant cane is third out of 20 in Montserrat and sixth out of nine in Nevis.

AUSTRALIAN SUGAR CANE BEETLES AND THEIR ALLIES. *J. F. Illingworth and A. P. Dodd. Bulletin 16, Division of Entomology, Bureau of Sugar Experiment Stations. Queensland. 1921. (104 pages and 17 plates.)*

Scarabaeids to the number of 50 species have been taken in the cane fields of Australia, but fortunately the great majority of these are held in check by natural controls, and only a few species are so abundant as to menace the industry. The first-named author undertook the investigation of these pests in June 1917, and made a thorough study of them, as well as collating the considerable work that had been done on their life histories during the preceding six years by the local officers and others. As *Lepidoderma albohirtum* extends right down the coast of Queensland and is regarded as doing the most damage in the cane fields, this species is discussed in greater detail than any other in the bulletin. It is a large, grey beetle which passes through its various stages in about a year. In the frontispiece a fine coloured plate reproduces in natural size and colour the various stages in its life history, from the cluster of eggs in the rudely formed "nest" to the mature beetle, the latter being about 1¼ ins. long and nearly ¾ of an inch broad, while the grub is considerably larger. Sections are devoted to the history of the literature on the pest, the nature of the injury to the cane plant, its habits and life history, the emergence of the beetles, evening flight and mating habits, morning flight, midday flight, ovipositing, duration of aerial life, and stages of development; and this chapter is replete with interesting observations and useful summaries. A chapter by the second-named author follows with a careful enumeration of the common trees surrounding the cane fields, the details of which are drawn from personal observations on 34 feeding trees belonging to 12 families and 30 other trees. The trees are divided into four main classes, namely, those constantly and habitually attacked (20), such as are occasionally or rarely eaten (14), those in which the beetles congregate for shelter during the day, usually trees with dense foliage (11), and common trees not known to be affected by the beetles (19). From this it is claimed that the elimination of the feeding trees will not interfere with the important growth of trees near the fields, although it seems possible that such action might cause the beetles to change their preferences.

A second shorter chapter deals with *Lepidiota frenchi*, a smaller, dark brown beetle, which has a longer life cycle of about two years. These emerge in enormous numbers, but are happily more local in their occurrence; where they occur they are probably little if at all less harmful, because of their much longer larval or feeding period. Twenty pages, again by DODD, are devoted to related beetles and their allies found in the cane fields, and contain various details collected as to their stages, habits and food plants; 54 distinct species are thus dealt with. An important chapter follows on the factors of control, and a copious bibliography brings the bulletin to a close. The paper is illustrated by 17 plates, largely the work of E. Jarvis, those figuring the various beetles being of natural size and colour, so that they can easily be recognized. Apart from these pictures of the beetles, perhaps the most instructive plate is one giving a graphic demonstration of the life cycle of *Lepidiota frenchi*, showing its position in the ground at different periods and the effect of its presence on the cane plant. From the relative size of the cane plants in this diagram, it would appear that they are more seriously affected by the grubs during the second year of great development.

NATURAL ENEMIES OF THE SUGAR CANE BEETLES IN QUEENSLAND. *J. F. Illingworth. Bulletin 13, Division of Entomology, Bureau of Sugar Cane Experiment Stations, Queensland. 1921.*

This bulletin deals principally with animal and insect enemies of the beetles found in the cane fields, their fungus diseases having been discussed in a previous bulletin of the same series.[1] The writer emphasizes the importance of these organisms in the economy of nature as, even in the case of our worst pests, natural enemies undoubtedly destroy by far the greater numbers. And yet with those that escape, probably less than 10 per cent., we have a keen struggle for supremacy. Australia appears to be the natural home of the Scarabaeid beetles, this fauna being perhaps the richest in the world; and as a consequence their natural enemies are equally numerous. With such an array against them, the question arises how it is that certain beetles can appear in such hordes as to devastate the crops. The conclusion arrived at is that the clearing of the forests and the close planting of canes in the fields have upset the balance of nature. Birds have been greatly reduced and many of the parasitic wasps dependent on the wild flowers for their food of nectar, have been driven into wilder parts where the grubs are also present. Some 50 Scoliids and 300 Thynnids have been described from Australia and predaceous and parasitic insects generally appear to be particularly abundant; but these useful insects are themselves frequently parasitized, and we at once see what an extraordinary complex has been built up in nature for the maintenance of an equilibrium, and how dangerous it is to introduce such radical changes as that described above.

After such general remarks, the author proceeds to enumerate the various natural enemies of the beetles, class by class. Among the mammals, a high tribute is paid to the bandicoot, a marsupial resembling a large rat, which, although omnivorous, has proved on dissection to feed largely on both grubs and beetles. Flying foxes (large bats) and moles are also useful. Less is known about frogs and lizards, but they are of large size and, where present, should prove formidable insect enemies. Birds are however easily the most useful allies, and it is surprising how quickly crows and ibises will clear out an infested area, while poultry and other birds are always ready to devote their attention to all stages of beetle life. With the predacious insects are classed the mites and centipedes, but much greater attention is paid to the parasitic insects. Of these the Scoliid wasps appear to be the most useful, and details are given concerning their habits, the importance of nectar-bearing plants for their food and the occurrence of hyperparasites preying upon them. Shorter sections deal with the Thyinnidae, Dexiidae and Tachinidae. This paper like the last is well illustrated. There are seven plates, some of them coloured and executed by E. Jarvis; and of these the most striking are life size photographs in series (1) of the oviposition and development of Campsomeris on white grub, and (2) the gradual degeneration of the tissues of the grub under the influence of the fungus Metarrhizium. A bibliography of 48 papers is added.

C. A. B.

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[1] A study of natural methods of control of white grubs, *Bulletin 1[illegible], 1921* (referred to in *I.S.J.*, 1921, p. 608).

Correspondence.

DEMERARA SEEDLINGS "NOT WANTED."

To the Editor, "The International Sugar Journal."

Sir,—In his 1921 Report, reviewed in your last issue,[1] Mr. Crabtree, the Superintendent of the recently instituted British Guiana Planters Experiment Station, says no country in the world wants British Guiana seedlings. Of course it does not, as since the Straits Settlements gave up sugar production, there is no sugar-producing country in the world where the conditions of cultivation, soil, climate, drainage, etc., resemble those of British Guiana. A universal seedling has not yet been discovered, and in British Guiana canes are evolved which are found to suit the conditions under which they have to grow. Hence the predominence of Demerara Seedlings on the Demerara cultivation.

In this connexion it may be remarked that Demerara Seedling D 74 has been a great boon to Louisiana. It was one of the earliest produced there before much was known about seedlings. It went on to the estates, but was found unsuitable for the very reason which made it acceptable to Louisiana, viz., its short period of growth before ripening.

Frederic I. Scard.

The Japanese Beet Sugar Industry.

Some Figures of Production.

By the courtesy of Messrs. Suzuki & Co. we are enabled to reproduce the following figures of the Japanese 1922 beet sugar production, as compiled in August :—

Districts in Hokkaido.	Acreage in "cho."	Estimated Beet Crop, piculs.	Estimated Beet Crop, picul per "cho."[2]	Yield, per cent.	Sugar Yield, piculs.
Kasai	3060	765,000	2·50	10	76,500
Abashiri	2066	516,650	2·50	10	51,650
Kamikawa	496	124,000	2·50	10	12,400
Sorachi	200	50,000	2·50	10	5,000
Kushiro	130	32,500	2·50	10	3,250
Soya	100	25,000	2·50	10	2,500
Total	6052	1,513,000	2·50	—	151,300

Germination was good, weather was favourable; owing, however, to the flood over Hokkaido at the end of August, some damage was done to the beet crop, but the extent is said to be slight. Regarding the crop per cho, this is expected to be at an average of 3·50 piculs this year, but the foregoing was calculated at 2·50, which is the usual average year.

At Dordrecht, Holland, a demonstration of continuous carbonatation on the laboratory scale took place at a meeting of the Dutch beet sugar manufacturers[3] and it was shown that the same results in respect of purity, colour, and ease of filtration are obtained as in ordinary intermittent carbonatation. A discussion of the theory of carbonatation followed, and it was mentioned that according to Prof. Hondius Boldingh when the calcium carbonate is first formed it is in a meta-stable condition, probably colloidal, and is then capable of adsorbing impurities from the juice. Later, however, it changes into the crystalline state, and precipitates.

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[1] *I.S.J.*, 1922, 592.

[2] 1 cho is 2·4507 acres. 16·8 piculs = 1 long ton.

[3] *Tijdschrift*, 1922, No. 10, 174-178, 181-186.

British Colonial Reports.

BARBADOS (1921-22.)[1]

The sugar crop exported (36,000 tons) was the result of two years' continued dry weather, the rainfall for 1920, on which the results of the 1921 crop (reaped in February to June) mainly depend, having been only 42·55 inches, which was over 21 inches below the average of the preceding five years. As the crop was produced under exceptionally costly conditions, all preparations having taken place in a period of very high prices, and the price had fallen to about one-fourth of the record figures ruling in 1920, the losses of estates were very heavy. On 31st May, 1921, the Sugar Industry Agricultural Bank returns showed that out of £538,302 loaned in 1920-21 to 154 owners, £462,107 was still outstanding. The financial results of the crop are by no means complete at this date, but the amount outstanding was quite unprecedented.

This position had naturally led to a severe restriction of credit on the part of the banks, which made the financing of the 1922 crop a difficult matter. Further details of the position will be found in the financial section. The difficulty was partly overcome but not removed, and as the outlook for the 1922 crop towards the end of 1921 was also singularly unpromising, proposals were made that the Government should come to the assistance of the Sugar Industry Agricultural Bank by guaranteeing advances to be made during the latter part of 1922 for the cultivation of the crop of 1923. The results of the 1922 crop, owing to late rains, proved more favourable than had at first been anticipated, but still involved losses to the very great majority of estates. Meanwhile, after considerable discussion and negotiation, proposals had been formulated by which the Government undertook to guarantee advances made to the Sugar Industry Bank for the purposes of the 1923 crop; on this condition the Banks undertook to advance up to £450,000 for this purpose. As, however, the guarantee was confined to loans made through the Sugar Bank to owners and others who were not in a position to secure funds by other means, it is probable that the amount required will not reach this figure. This was an unusual measure, justified, however, by the imperative necessity of securing that estates shall in no circumstances be allowed to go out of cultivation. With a population of 940 persons to the square mile, the majority of whom are directly or indirectly dependent on the employment offered by sugar estates or in the handling of the sugar crop, the results of any serious interruption in the cultivation of estates can be easily realised.

The position has not been made easier by the fact that during the "boom" preceding the present period of "hard times" many estates changed hands at very high prices, and are now burdened with a capital outlay which present conditions are quite unable to support. The full consequences of this situation have not yet revealed themselves, but instances have occurred of purchases made at high prices during the boom being subsequently abandoned with the loss of large instalments of the purchase price.

The Barbados crop is reaped between February and June, and the figures given below though nominally the exports for the year may be accepted as roughly corresponding to the crop results. Exports of sugar since 1917 have been as follows (molasses being reduced to its equivalent in sugar):—

1917	69,367 tons.	1920	48,212 tons.
1918..	57,191 „	1921..	36,005 „
1919	69,628 „		

Not only was the 1922 output small, but the cost of production was unusually high, as a large proportion of manures and other estate supplies had been purchased at the height of the "boom" prices. When in addition to these difficulties the planter was faced with a heavy fall in price, it can be easily understood that 1921 was one of the most difficult years through which the industry has passed. Nearly all estates were worked at a loss, in many cases a substantial loss, and the difficulty of financing estates for the ensuing crop caused widespread anxiety. Fortunately, that difficulty was overcome as explained elsewhere, and, given one or two favourable years, the industry may well be re-established on a secure basis in a very short period.

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[1] Extracted from Colonial Reports, No. 1134 (Barbados).

The continued loss from insects and other pests, however, causes some misgiving. The Director of Agriculture again reports considerable damage from the Root Borer and the Brown Hard Back. The Mosaic Disease, which was brought to notice in 1920, was the subject of special measures of control. A commission was appointed in November, 1921, including representative planters, to carry out a careful inspection of lands for Mosaic Disease and take measures for its eradication. The Commission was granted extensive powers for securing the destruction of infected plants. The inspectors appointed by the Commission found the disease widely prevalent.

The decrease in value of sugar and molasses shipped during 1921 was as follows:—

	1920. £	1921. £	*Decrease.* £
Sugar	2,203,052	515,187	1,687,865
Molasses	1,310,524	403.927	906,597

25,867 gallons of Rum were exported as compared with 30,310 in 1920, but the value increased to £15,520 as compared with £6,820.

The average prices prevailing for sugar and molasses during the last five years are given below:—

	1917.			1918.			1919.			1920.			1921.		
	£	*s.*	*d.*	*£*	*s.*	*d.*	*£*	*s.*	*d.*	*£*	*s.*	*d.*	*£*	*s.*	*d.*
Sugar, per ton	20	10	0	20	10	0	28	10	0	63	15	0	22	10	0
Molasses per gallon ..		1	1⅛		1	7⅛		1	10		3	1		1	5

The distribution of the sugar and molasses crop was as follows:—

	Sugar. £	*Molasses.* £
United Kingdom	92,055	—
Canada	335,351	316,624
Newfoundland	80	52,342
British West Indies	42,240	818
United States of America	30,200	34,143
Elsewhere	14,261	—
	£515,187	£403,927

The new Barbados tariff giving a 50 per cent. preference on imports of British origin in accordance with the Canada-West Indies Trade Agreement of 1920 was introduced in June, 1921, but it is too soon to gauge its effect with any certainty, more especially in view of the general depression of trade and the fluctuations in exchange occurring in that year. It is satisfactory to note, however, that 71 per cent. of the imports were of British origin.

TRINIDAD.[1]

The staple agricultural products of Trinidad are cacao, coconuts and sugar with its by-products of molasses and rum. All have been affected by the unusual conditions prevailing in the world's markets. The year 1921 was one of the wettest on record, the fall of 75·51 inches at the Botanic Gardens having been surpassed only ten times in 60 years from 1862.

The 1921 sugar crop was 54,933 tons, about 3,500 tons below that of 1920, the shortage being due to heavy rains preventing cartage and reaping. The exports for 1921 were Sugar 46,149 tons, value £1,458,514; Molasses 60,729 gallons, value £2,346; Rum 162,337 gallons, value £58,552

The considerable success achieved in the campaign waged against the Mosaic disease gives reason to hope that with continued watchfulness and the co-operation of the planters, large and small, the disease will be prevented from doing any considerable harm in the future. Very little damage was done by the froghopper owing to the prevalence of parasites whose survival was favoured by the mildness of the dry season. Attention is being chiefly given now to the investigation of soil conditions, as attacks by froghoppers are apparently very largely encouraged by soil conditions.

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[1] Extracted from Colonial Office Reports, No. 1135 (Trinidad and Tobago).

Per Capita Consumption of Sugar.

Licht's Recent Figures.

Messrs. F. O. LICHT, the German statisticians, give the following figures of per capita sugar consumption for the 1921–22 season. We have added the equivalent in lbs.

NORTH AMERICA.	Kg.	lbs.
United States	44·80	99
Canada	44·25	97
Mexico	9·06	20
Central America	4·07	9
Haiti and San Domingo	2·80	6
British West Indies	3·40	7
French West Indies	2·50	5

SOUTH AMERICA.		
Brazil	9·06	20
Argentina	25·82	57
Peru	9·60	21
Venezuela	4·98	11
Columbia	2·02	4
Ecuador	10·87	24
Uruguay	2·80	6
British Guiana	3·40	7
Dutch Guiana	2·80	6

EUROPE.		
Great Britain	32·16	70
France	16·30	35
Germany	24·91	54
Czecho-Slovakia	14·50	32
Poland	6·34	14
Holland	30·80	68
Belgium	19·93	44

EUROPE (*contd.*).	Kg.	lbs.
Denmark	44·80	99
Sweden	33·52	74
Italy	5·43	12
Spain	7·70	17
Switzerland	33·97	75
Hungary	7·85	17
Austria	10·87	24
Rumania	6·25	14
Bulgaria	5·45	12
Jugo-Slavia	5·43	12
Russia	2·26	5

AFRICA		
Egypt	12·23	27
Mauritius	5·43	12
Réunion	3·17	7
Mozambique	3·17	7
South Africa	25·36	56

ASIA.		
British India	9·25	20
Java	12·26	27
Japan and Formosa	6·80	15
China	2·1	5
Philippines	10·87	24
AUSTRALIA	45·30	100

It was lately reported from Berlin that the request of the German beet growers for an increase in the price of their roots to approximately 400 marks per 50 kgs. has been acceded to by the Government. In a short time, therefore, the present price of sugar will probably rise from 2500 to 5000 marks per 50 kg. To this must be added the cost of the sacks, freight and commission, so that the wholesale price will shortly amount to about 7000 marks per 50 kgs. As the price of foreign sugar is only 7500 marks, the difference between home and foreign sugar will be considerably reduced.

Castings furnished for evaporators and pans may sometimes be porous in spots, and when such castings are supplied, the factory engineer will be surprised to observe how much better after a painting process the vacuum will hold up, a very slight leak only sufficing to reduce it quite considerably. After the erection of an evaporator or pan, before the lagging is put on, the bodies and piping should be covered with a thin mixture of paint while the apparatus stands under vacuum[1]. Every stroke of the brush should be watched by the painter, so that he may detect pin-holes and defective joints. These leaks should be painted, and re-painted, allowing each successive coat to dry, until the apparatus is entirely air-tight.

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[1] *Sugar News*, **1922**, **3**, No. 6, 269-270.

Review of Current Technical Literature.[1]

JARONU, CUBA'S LATEST MILL. *Anon.* *Facts about Sugar, 1922, 14, No. 3, 50-51.*

At present the milling plant consists of two tandems of 18 rollers and two crushers, each made by the Fulton Iron Works, the being rolls 36 in. × 84 in., with journals 18 in. × 24 in., to carry a maximum hydraulic pressure of 542 tons on the top roll. All the grooving on the rolls is ½ in. pitch. Each crusher and 3-roller mill is driven by an independent 200 h.p. slip-ring motor, running at 450 revs. per min.; and each tandem has its own turbo-generator, constructed to run at 3600 revs. per min., with a direct steam pressure of 80 lbs., and 10 lbs. back-pressure. Two juice strainers, run by 10 h.p. motors separate the trash from the raw juice. By means of 180 galls. per min. bronze centrifugal pumps, located at the side of the last mills, the juice from these may be returned to any of the first four for maceration purposes. The combined juice from the mills is pumped to four Richardson automatic scales located on the third floor of the defecation department, these dumping 3000 lbs. of juice at each weighing. Four liming tanks, having a capacity of 4500 gallons each, are located on the floor below the scales, being discharged by any of three 600 galls. per min. centrifugal pumps located on the ground floor. There are six horizontal juice heaters, each with 1200 sq. ft. of heating surface. These are piped to use live or exhaust steam, or the vapours from the first body of the sextuple effect, working as a pre-evaporator or double effect

In the clarification department, fourteen 8500-gallon defecators 14 ft. × 10 ft. × 7 ft. equipped with heating coils are provided, these being arranged in two rows on the third floor next to the juice scales. Twenty plate-and-frame filter presses are located on an extension of the floor below the defecators, each press carrying 42 plates, 40 in. × 40 in. × 1½ in. These presses are fed by two centrifugal pumps 120 galls. per min. for starting at low pressure, and one 16 in. × 10 in. × 16 in. filter-press pump for higher pressure. On the ground floor are located the lime pumps and mixing tanks for making the milk-of-lime. For evaporating the juice two sextuple effects have been installed, each body of which has 7000 sq. ft. of heating surface. These are so constructed that by a combination of valves in the vapour pipes, steam and supply lines, they can be worked triple, quadruple, or quintuple effect. One body can be cut off and used as double effect, or pre-evaporator, in connexion with the juice-heaters. The steam boxes of each sextuple are drained by three duplex Edwards pumps, constructed by the Worthington Pump Company. Each evaporator has its own seamless welded steel condenser, and a 23 in. × 12 in. vacuum pump driven by a 100 h.p. motor.

Seven 14-ft. vacuum pans, each with separate condenser and air pump, have been installed; but space has been left for additional pans. Five of these vacuum pans are of calandria type, with tubes 42 in. × 4 in., containing 3000 sq. ft. of heating surface, and additional heating surface of 300 sq. ft. in coils beneath the calandria. The other two are coil pans containing 2000 sq. ft. of heating surface. The Corliss valve trap is used on all pan coils. Each condenser has its individual vacuum pump, 17 in. × 10 in. Injection water is supplied by any or all four 10,000 galls. per min. pumps, located in the end of the power house, and so piped as to serve any vacuum pan or evaporator. There are thirty-six crystallizers of the semi-open type, arranged so that ten may be used for either first or second massecuites, and the rest for low grades. These are filled by scroll conveyors, moved by 40 h.p. motors. The centrifugals were made by Watson, Laidlaw & Co., and are all 40 in. × 24 in. Weston type. There are eight self-dischargers for first sugar, and twelve machines equipped with Roberts-Gibson dischargers for the second sugar. Four Richardson automatic scales have been erected for weighing and bagging the sugar. The molasses is removed by triplex pumps 7 in. × 10 in., having a capacity of 100 galls. per min. Thirty 40 in. × 24 in. centrifugals equipped with dischargers, have been furnished to purge the low grade sugars. These discharge into scroll conveyors followed by a mingler. Three 20 in. × 10 in. × 24 in. steam-driven magma pumps elevate the magma to a seed grain crystallizer near the pan floor. These pumps, with the oil and filter-press pumps, are the only steam cylinders in the factory.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*

Fourteen tanks on the pan floor, 20 ft. × 10 ft. × 8 ft. deep furnish ample room for the storage of molasses and syrups. There is auxiliary storage in twelve tanks 12 ft. × 10 ft. × 5 ft. above the floor.

A bag conveyor leads from the centrifugal floor to the storage warehouse which has a capacity of 175,000 bags of sugar. Four tanks, having a total capacity of 5,000,000 gallons, are used for storage of final molasses. The power plant of the mill consists of Babcock & Wilcox water-tube boilers of 11,124 h.p. capacity, connected to two concrete stacks 240 ft. high × 16 ft. internal diam. The latest design of hearth type furnace, with an equivalent grate area of 63 sq. ft., is used in connexion with the eight larger units, air being supplied to the tuyeres by Sturtevant multivane fans. The smaller boilers have grates with 36 sq. ft. area. All boilers are equipped with soot blowers. The furnaces are equipped with Locket automatic burners, to permit the use of oil fuel. Condensed water from the vacuum pans and evaporators is used for boiler feed, the excess of which is collected in a 500,000-gallon steel tank. There are three 400 galls. per min. centrifugal pumps, driven by 100 h.p. motors, for feeding the boilers during operation, but an auxiliary centrifugal pump driven by a direct-connected steam turbine may be used for starting, or in case of interruption of the electric current the bagasse is supplied to the furnaces by slat conveyors, the entrance to each furnace being closed by rotary feeders. Central Jaronu was built under the direction of ANTONIO G. MENDOZA, of Havana, who was also the builder of its sister mill, Central Cunagua, erected in 1917. Mr. MENDOZA, as vice-president and manager, directs its operations. In the 1921-22 season the output of Jaronu was 370,441 bags (about 53,000 tons).

ECONOMY OF STEAM IN CUBAN SUGAR FACTORIES. *N. A. Helmer*. *La. Planter, 1922, 68, No. 18, 287.*

"A fairly close acquaintance with the majority of sugar factories in Cuba, during a career of over 20 years, has brought to the writer's observation cases of wastefulness not always caused by a personnel deficient in ability or intelligence. Defective construction or equipment could be blamed in the majority of cases but there stand out many that were due to a misconception of economic values on the part of the management, a viewpoint that can only be understood on the theory of continuous operation as the first commandment and maximum production as the second. . . . . The steam wastes, however, are of a character that defy any particular classification. Even to-day, few are the plants where any pretence is made of studying steam economy beyond plastering the boiler setting, cleaning the products of combustion from one side of the heating surface and the scale from the other. To correct any lack of steam generation, more fuel, more boilers or both are considered the accepted panacea for such conditions; and the remodeling of the piping or the installation of traps, separators, heat-saving devices or recording apparatus savours too much of the experimental station idea to receive serious consideration. . . . . I venture the statement that 95 per cent. of the boilers in Cuban sugar plants operate continuously throughout the crop without any effort being made to determine the stack temperatures, the draft, the composition of the gases, the quality of the fuel, the quantity evaporated per sq. ft. of heating surface, or any other data that would permit an intelligent diagnosis of the troubles. There exists as a rule between the steam consuming and steam producing members of the crew, a feeling of antagonism that is impossible to disperse due to the fact that no data exist upon which to base a decision as to whether the steam is being used or wastefully produced. . . . If one-tenth of the interest now devoted to increasing the mill extraction, the sucrose extraction from the final molasses, were applied to the control of heat extraction from the furnaces and transference to the material in process, I have no doubt that it would at once release to the cane fields a quantity of labour, now used to cut, haul, stack and burn wood fuel. It would require engineers rather than high grade mechanics to operate such a control, men who think in terms of B.T.U.'s rather than lbs. per sq. in.; but were such a system installed, it would need no stretch of the imagination to believe that Cuba would save several million dollars in fuel, conserve the forest growth, and run factories with a fractionless personnel whose efforts in combination would result in a generally lowered cost of production. . . . ."

Manufacture of Direct Consumption White Sugar in Russia before the War, using Weisberg's Sulphi-Carbonatation Process.

C. Brendel. *Centralblatt für die Zuckerindustrie, 1922, 30, No. 51, 1447–1448.*

According to this writer, previous to the war, sugar manufacture was carried on in Russia generally with efficiency, and all the factories were capable of producing a good quality of white crystals, which were either consumed directly, or sent to refineries to be worked up into special grades. These direct consumption crystals polarized 99·7 to 99·8°, and were very white and dry; and in their production molasses was the only other product that was turned out, the second sugars being melted up and put into operation again. It is said that Weisberg's so-called sulphi-carbonatation process[1] had been introduced into these factories; and that the author had operated it with such highly satisfactory results that he recommended it to the attention of his colleagues in Germany, where more attention is now being paid to the production of direct consumption crystals than ever before. Weisberg's process consists of a particular method of applying sulphitation, the alkali salts in the juice being converted into the corresponding sulphites after the first carbonatation, in which form they subsequently play the rôle of reducing agents during evaporation and boiling. Before he arrived at this *modus operandi*, he had observed that calcium sulphite even at high temperature is difficultly soluble in neutral or alkaline sugar solutions, and especially is its solubility diminished during the formation of calcium carbonate, the more so if the temperature is high. It seemed to result from these observations that the only stage at which sulphurous acid should be applied is between the first and second carbonatations, preferably using the filtered juice, so as to reduce the danger of supersaturation. On so doing, he found that the sodium and potassium sulphites formed persisted throughout the subsequent operations of evaporation and boiling, preventing coloration, decomposing nitrogen compounds, and finally passing into the last products, where their influence is said to be non-melassigenic, in contradi-tinction to the corresponding carbonates. Practice has confirmed the belief that the precipitation of the calcium organic acid salts is more complete in the presence of sulphites than in that of carbonates, syrups that have preserved their alkalinity and are low in lime content resulting. However, when operating with inferior roots (rotten or frozen) there is present an excess of sodium and potassium organic acid salts, which form insoluble salts with lime, the alkalis combining with the organic acids. In these circumstances, since all the alkali available is already combined, it becomes necessary to make an addition of sodium hydroxide to the juice before carbonating, this base being subsequently converted into the sulphite. Weisberg's process permits the production of a very pale juice having as low a calcium content as 0·005 per cent., while the syrup is such that when diluted to the density of the juice it is not twice as dark as ordinarily, but is generally lighter, and never more coloured. It is seldom that the syrup from the evaporators has an alkalinity higher than 0·015 per cent. CaO, when this process has been applied. Further it is stated that boiling is particularly easy; that the white sugar is of remarkably good quality; and that the molasses is well exhausted.

Action of Lime on the Protein Substances separating during the Defecation of Beet Juice.

Vl. Stanek. *Zeitsch. Zuckerind. cecho-Slov. Republik, 1922, 46, Nos. 49 and 50, 663–669, 671–676.*

Many chemists believe that in effecting clarification in the beet sugar factory when lime is added to the juice, and the mixture is heated, it acts on the precipitated albumin to an appreciable extent,[2] so that a sufficient amount of degradation products is formed to influence the extraction of sugar owing to their strong molasses-forming nature. Certain writers therefore suggest that previous to liming, the juice should be boiled with or without the addition of a slight quantity of sulphurous or phosphoric acid, and that the precipitate obtained should be removed previous to the addition of the lime. On the other hand, Herzfeld[3] from observations of the purity after the completion of carbonatation came to the view that under the conditions prevailing in practice only a very little non-sugar could pass into solution as the result of the action of the lime on the albumin. However, these experiments carried out at Berlin do not appear to preclude the possibility that much dry substance may have passed into solution during liming to be later precipitated together with other non-sugars when the carbon dioxide is passed in. A given amount of lime can precipitate (either chemically or "mechanically") only a definit amount of non-sugar; and therefore it follows that if the amount of soluble nitrogenous non-sugars is increased as the result of the degredation of the proteins by lime, then the rise in purity will be smaller than it would otherwise have been if the same amount of lime had been permitted to act during a shorter period of time. It is thus of interest to learn the nature and amount of the products which form as the result of the action of the lime on the precipitated non-sugars; and with this purpose in view a quantity of the precipitate resulting from heating beet diffusion juice with milk-of-lime was prepared, purified, analysed, and used in a series of experiments (details of which it is unnecessary to give here), the following being the conclusions to which they led: As the result of the action of lime and heat on the coagulable non-sugars of beet juice, a considerable amount of matter goes into solution, e.g., about 11 per cent. after ¼ hour at 85°C. This extract is very rich in ash containing lime and a high proportion of phosphoric acid; but the amount of ash diminishes with the duration of the action of the lime, from which one may conclude that at first simple bodies (acids of low molecular weight), and later more complicated ones (perhaps albumoses and peptones) are split off. Probably the phosphoric acid found in the ash of the extract originates from calcium glycero-phosphates, which result from the decomposition of lecithin or perhaps of di-stearin-glycero-phosphoric acid. Another decomposition production of lecithin found was choline, but it was not possible to isolate or even detect betaine. Regarding the effect of carbonatation on the non-sugars thus resulting by the alkaline hydrolysis of beet albumin, it was found that these bodies are partly precipitated with the scums, and the more completely the more lime is used; while that which remains in the carbonated juice causes a lowering of the purity amounting approximately to 0·03 to 0·16 per cent. Regarding the nature of the nitrogenous bodies in the extract, mostly these appear to resemble albumoses, peptones, and polypeptides; but the isolation of amino-acids could not be effected.

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[1] French Patent, 455,936; *I.S J.*, 1914, 440; 1922, 612.

[2] Sellier, *Bull. Assoc. Chim. Sucr.*, 20, 1251.

[3] *Vereinszeitschrift*, 1893, 173.

Experiments on the Production of Power Alcohol and Paper Pulp from Bagasse.

Gilbert H. Fowler and B. Bannerjee. Journal of the Indian Institute of Science, 1921, Vol. 4, Part XV, 241-260.

Operating with sun-dried bagasse containing about 7 per cent. of sugar, and following in general the conditions employed by Kressmann,[1] the authors found that a greater percentage of reducing sugars could be obtained from this material than has hitherto resulted from the hydrolysis of any other wood waste. They were able to produce 30 per cent. of reducing sugars and 8 to 9 per cent. of alcohol in their laboratory experiments with bagasse; whereas Kressmann's result in the case of white spruce was 23 and 6 to 7·5 per cent. respectively. It was found that the best conditions for effecting the hydrolysis are to heat the bagasse with a solution of sulphuric acid (containing 0·35 to 0·5 per cent. of H_2SO_4), the proportion of acid being 6 per cent. of the weight of fibre present, employing a pressure of 7½ atmospheres, and a period of 15 to 30 minutes, though little loss of sugar occurred *ceteris paribus* if this time was prolonged to two hours. Actually the highest amount of reducing sugars formed was 36 per cent., from which 7 per cent. representing the sugar originally present in the bagasse, must be deducted. However, some difficulty was experienced in the direct fermentation of the saccharine liquid (even after clarification with lime), though it is said that a large percentage can be fermented when the liquid is diluted with a solution of fermentable sugar, when, as stated, the net yield was 8 to 9 per cent. Sir Charles Bedford has pointed out to the authors that the amount of water present in the liquid in their auto-clave is economically excessive, involving subsequent cost in concentration or in distillation; but the authors' reply to this is that "the conditions of experiment do not permit greater concentration, such as could have been obtained, e.g., by injection of steam." It is stated that the residual fibre taken from the auto-clave can be pulped by heating under pressure with caustic soda to form a satisfactory material for the manufacture of cheap and thick grades of paper.

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[1] *J. Ind. Eng. Chem.*, 1914, 625; 1915, 920.

CARBONATATION OF BEET JUICE, USING DOLOMITIC LIME. *Wenzel Kohn.* *Zeitsch. Zuckerind. cecho-Slovak. Republik, 1922, 47 (iv), Nos. 1 and 2, 9-10, 13-19.*

In continuation of previous work by ANDRLIK and the writer,[1] the results of experiments on the use of dolomitic lime (that is a lime containing a high proportion of magnesia) for the defecation of beet juices are recorded, the following being a brief summary of the conclusions stated: On adding 0·3 per cent. of dolomitic lime (containing about 16·19 per cent. of MgO) to beet juice at 80°C., the precipitate produced rapidly subsided in some cases (though frequently the contrary was the case); with the addition of 0·4 per cent. a rapid settling of the precipitate could only be induced after the liquid had been carbonated to 0·01 per cent.; while the amounts above 0·4 per cent. the precipitate would hardly settle out at all. Using 0·3 per cent. of the dolomitic lime, a precipitate weighing 0·62 per cent. was separated. It contained 5·2 per cent. of phosphor acid and 1·6 per cent. of nitrogen, and the writer appears to regard it as a substance of some possible commercial value.

STATUS OF THE SUGAR CHEMIST IN CUBA. *C. N. Ageton.*[2] *Facts about Sugar, 1922, 14, No. 24, 482-483.*

"If, for any reason, the chemist is not *persona grata* with the superintendent, he will lose his position. But where in the name of logic did such a vicious system originate, when the chemist is the only man in the mill organization who approaches being in a position to check up the quality of the superintendent's work? As the system exists, it means that the superintendent, or the administrator, or both, are in a position absolutely to control the figures entering into the mill statistics, which constitute the only record or measure of their efficiency . . . ." A young chemist "was forced to take samples of final molasses in such manner as to falsify the samples, and thereby make a showing on sucrose lost in final molasses favourable to the mill superintendent. He knew this part of his work was false and dishonest; he reported to his immediate superior that part of the laboratory equipment was not adequate, that it caused serious errors in his determinations used in compiling the mill statistics, but he was told what to do, and was informed that he must keep his mouth shut on pain of instant dismissal. He carried out his instructions, helped to compile statistics that were replete with errors and falsifications—and kept his job. This is one of no less than *twenty* such cases that have come to the knowledge of the writer during the past month. Names and dates and places could be given—and proven—if it were necessary. Why is this system so firmly fixed in the Cuban sugar industry? Mill superintendents and administrators are not above the possibility of wrong doing; why should they be allowed to dominate their auditors? There is an element of the ludicrous in maintaining a finished system of accounting in the general affairs of a sugar company, while mill operation, the one major operation that must produce loss or profit, is carried on from season to season without auditing of any kind, or with accounting that is worse than none . . . ."

"To sum up the substance of these reflections: it is obvious to any thinking man that chemical control in sugar factories is nothing more than accounting. Why, then, not make this accounting accurate, honest and helpful? It will probably be admitted without argument that adequate and accurate accounting is an indispensable part of modern business administration. A voice whispers that if these principles were adopted in the Cuban sugar industry, if the right kind of administration of the chemical control department were introduced generally, there would be depositions in high places and many of the large would become small. Nevertheless, the following suggestions are respectfully made to those in positions where the power to inaugurate changes reposes: Employ a chemist who is competent and hold him responsible for strict accuracy and honesty in the determination of all figures and reports bearing on the activities in the mill and *batey*. Provide him with adequate laboratory and assistance. Arrange that he shall spend his time in doing what he is trained to do. Turn the mill statistics over to the accounting department for compilation. Make the chemist independent of the administrator and mill superintendent, in order that he may be able at all times to provide a real check on these officials. Pay him a decent living wage. He will be content with a modest salary; but it should be enough so that he can live comfortably, and as befits a member of an honourable and useful profession . . . ."

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[1] *I.S.J.*, 1922, 270, 327, 549.

[2] Of The American Laboratories, Havana.

ELECTRICAL POWER EQUIPMENT AT THE BALTIMORE REFINERY, U.S.A. *Anon. Chemical Trade Journal, 1922, 71, No. 1851, 582.*

Particulars are to hand of the new power plant of the new refinery of the American Sugar Refining Co. on the Patapsco River at Baltimore, Maryland, U.S.A. It is interesting to note that the power equipment of this sugar-house (the last word in American practice) consists of reciprocating engines instead of steam turbines for the pass-out steam, and electric drive throughout with D/C instead of A/C motors. A D/C motor has the advantage that it can be designed for any speed, and may be varied in revolutions per minute within the wide range of 15 to 100 per cent. with the use of a cheap and adjustable field resister, whilst such variation in speed is obtained without excessive loss in efficiency. In addititon it will take a big overload with only a comparatively slightly reduced efficiency, and the cables can be used in separate conduits without any inductive troubles, so that large single cables can be laid in multiple, and the power and light cables can be run close to the signal and telephone cables without difficulty. The disadvantages of the D/C motor are that it is a little more costly to instal; it is more complicated; and there is liability to increased wear and tear. Further, transmission at great distances is not possible, because the voltage cannot be raised or lowered at will; whilst higher voltage is somewhat dangerous because of the exposed live metal parts and commutator difficulties. On the other hand, the A/C motor has the advantage that it is simpler; its first cost is slightly lower; and its maintenance is also less. The absence of commutators allows the generators to run at very high speed, which means also less floor space; while the transmission is very easy and economical at long distances, because the voltage can be raised to any point, and also it is safer. The disadvantage is that it is an inherently constant speed machine, and is therefore not, as a rule, so well adapted for refining, where variation in speed is essential. If an A/C motor is run at less than full load there is serious loss in efficiency; whilst there is also considerable trouble with A/C current due to induction and complications with the telephone and signal wires, and the necessity of transformer stations. Bearing all these factors in mind, therefore, there seems to be no doubt that D/C current has the advantage. Ordinary reciprocating engines have been used instead of steam turbines, because it was found by previous experience in other refineries belonging to the Company that it is impossible to prevent sugar getting into the boiler feed water and the steam. For example, the slightest leak in the coils of pans and tanks allows sugar to get into the steam, and so be carried to the condensing plant, and that find its way into the boilers. Under the influence of the high temperature in the boilers (over 350°F.) the sugar decomposes, forming complex acids which volatilise in the steam and corrode the blades of a steam turbine in a few months. It seems to be impossible to prevent this action by adding excess of alkali to the boiler feed-water, at any rate the difficulty of finding a solution of this problem has meant the scrapping of the turbines.

COMPARATIVE SWEETNESS AND PRESERVING QUALITY OF CANE AND BEET SUGARS. *James P. Ogilvie. Journal of the Society of Chemical Industry, 1922, 41, No. 16, 343–345R.*

THE VACHIER FILTER. (1) ***Rafael Vachier.*** *Communicated by letter dated October 25th, 1922.* (2) ***Anon.*** *La. Planter, 1922, 49, No. 1, 9.*

(1) It consists mainly of a closed tank, either cylindrical or U-shaped, inside of which is placed a series of metallic wire-cloth filter-leaves at intervals of 3 in. each, connected to an outside faucet, delivering the clear filtrate into an open trough. The liquor to be filtered is admitted to the bottom of the tank by opening a valve connecting the filter to the supply tanks. The filtering plates have a central water-tight hole carrying a hollow shaft from end to end of the filter, said shaft being provided with a set of scrapers and flushing pipes, which are screwed into place and rotated slowly by a suitable gear and motor. By setting these scrapers at a convenient distance from the filtering plates, and rotating them slowly while filtering, the thickness of the carbon or other cake is kept down to a minimum, and the rate of filtration increased considerably, besides the added advantage that the rotating scrapers act as paddles which keep the rest of the carbon from settling down at the bottom of the tank. When the filtering period is over, the liquor inside the tank is blown back to the feed tank by turning compressed air on to the top of the filter, after which water is allowed to run through, thus "sweetening-off" the cakes, this operation being a simple and rapid one. When the contents of the filter is ready to be discharged, a valve at the bottom connecting to the mixing tank is opened, and the scrapers brought nearer to the plates by actuating a controlling wheel which imparts a horizontal motion to the central rotating shaft and its scraping system, causing the cakes to fall; also, the valve on the waterline is opened for a while so that the water flows through the hollow shaft and out at the scrapers in a fan-shaped stream, rinsing off any particles left on the filtering plates. The filter is provided with a manifold connecting to all the faucets so as to use in a "reverse" way, either steam or air, and dislodge occasionally any particles that may have lodged in the filter-cloth.

(2) One of the most prominent features of this filter (which was originally designed for dealing with decolorizing carbon) is that the automatic mechanical cleaning is done in about two minutes by simply turning on a switch connected to a small electric motor coupled to the main rotating shaft of the machine, which in turn supports and also rotates a series of scrapers which tumble the cakes of carbon from the metallic filtering plates. These filtering plates are supported in a closed iron receptacle or tank and are made of a special weave metallic cloth which is resistant both to acids and alkalies, and to wear and tear. Another evident feature of this new filter is its high rate of filtration, as will be clearly seen from the following data taken from actual operation in large scale at a refinery using decolorizing carbon. Material filtered was raw sugar liquor at 30° Bé. (54·3° Brix); carbon used, 1 per cent. on solids; and capacity of filter, 400 sq. ft. filtering surface.

Tank.	Gals. filtered.	Time. H.	M.	Average Pressure.	Gals. sq. ft. hour.
No. 1	4000	0	55	11	10·8
,, 2	4000	1	10	23	8·3
,, 3	3690	1	0	16	9·2
,, 4	3259	0	55	25	8·1

These results refer to carbon which had been revivified several times and not to fresh material; and brilliant liquor free from all particles is said always to have been obtained. The pressure in the filter remains uniform, and the liquid is kept in constant agitation, so that the cake is formed evenly throughout. It is said that the metallic cloths on this new filter will last indefinitely and the usual annoyance and expense of changing cotton cloths often is done away with entirely. As the filtering plate is completely enclosed, and the filter itself hydraulically tested to a safe working pressure before being assembled, one is assured of the absence of leaks of any sort, making the filtration department a clean and agreeable place to work in.

CENTRIFUGAL PUMPS IN SUGAR CENTRALS. ***Irwin McNiece.*** *Sugar News;* through *Facts about Sugar, 1922, 14, No. 25, 498-501; 1922, 15, No. 2, 38-39.*

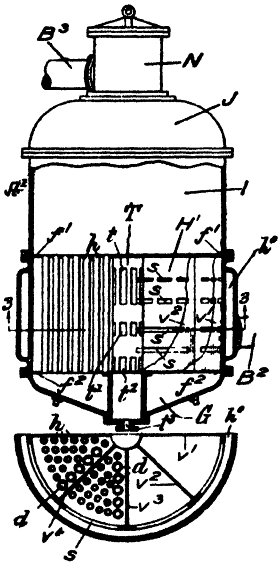
Discusses:—Functions of sugar-house pumps; centrifugal pump designs; production of vacuum; design of the impeller; calculation of curve; determination of velocity; dimensions of casing; and specific pumping problems.

Review of Recent Patents.[1]

UNITED STATES.

STEAM BELT OF A MULTIPLE EFFECT EVAPORATOR OR VACUUM PAN. *William H. P. Creighton*, of New Orleans, La., U.S.A. *1,424,992*. August 8th, 1922. (Three figures; ten claims.)

It is remarked in this specification that the design of evaporators and pans now generally in use violates the following essential requirements:—(1) That both heated liquid and heating medium should pass over the heating surfaces at every point at the highest possible velocity; and (2) that the amount of incondensible gases should be kept at a minimum. These defects are now overcome in the apparatus here described and illustrated. In the effect *A'*, the heating surface comprises numerous vertical tubes *h* of small diameter in which the liquid rises, and a few tubes *d*, of larger diameter favourably placed in each section, to act as downcomers instead of the large central downcomer *D* of the steam belt H. The steam belt H' is divided into cylindrical sectors by thin vertical plates V', V^2, V^3, V^4 extending from the tube sheet f' to the tube sheet f^2, and from the inner wall of the annular belt to a central exhaust pipe *T*, which is provided with openings *t*, t', and t^2 for each sector, with an escape passage t^3. This pipe *T* serves as an eduction pipe from the effect for condensate, for incondensible gases, and when "robbing" the effect of considerable steam. Similar radial plates corresponding to V' to V^4 should of course be provided on the opposite side of the apparatus. The inner wall of the annular belt *H'* is perforated opposite each sector by one or more horizontal openings *S*, *S*, the principal ones being below the level of the liquid maintained in the effect, as the most intense circulation is obtained in a tube by applying heat as near the bottom of the tube as possible.



The operation of the steam belt *H'* is as follows:—The pressure in the eduction tube *T* being low, steam will tend to enter each section from the annular chamber h°. The major steam current will be strong and low down and will induce a high liquid current in the tubes. A very large number of tubes are affected by this current in each sector. Losing heat, the steam decreases in volume. However, in its passage to the central exhaust pipe *T*, the vertical cross section of the steam path rapidly decreases, so that that steam velocity perpendicular to the tubes is substantially maintained. The construction calls for a short, direct and almost radial movement of the steam, incondensible gases, and condensate to the exit t^3, where they can be separated and sent to heaters, other effects, or to sweet-water pumps. The upper part of the liquid tubes is filled with steam which absorbs heat slowly. It is well to have some steam sweep the upper part of the tubes to carry incondensible gases to the exit as well as evaporate the liquid film clinging to the inside of the tubes. In "robbing" or "bleeding" an ordinary standard effect, the steam is removed before it enters the effect. In the new construction, it is taken off after it has passed through the effect, and by so doing it increases the efficiency of the heating surface by increasing the velocity of the steam past the heating surface of the tubes. By varying the width of the horizontal slots *S*, each section may be caused to receive practically the same amount of steam. To sum up:—This construction will cause high grade steam to impinge on more tubes and on that part of each tube that will induce the highest velocity of the liquid in the tube. Further, the condensate and incondensible gases are not allowed to remain in the heating chamber, but are swept in a short direct path to the exit.

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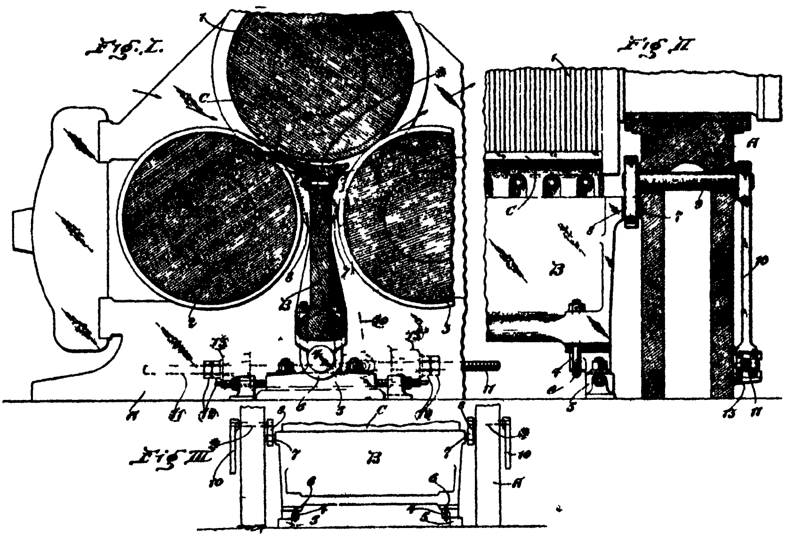
[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 2fr. 00 each).

MILL PROVIDED WITH A SCRAPING DEVICE. *Henry Hurter* (assignor to *Fulton Iron Works Co*) *1,422,979.* July 18th, 1922. (Three figures; two claims.)

This invention relates more particularly to a mill provided with a scraping device, the main object being to produce a strong, simple and efficient apparatus of this kind preferably comprising a turnbeam, a trash knife or scraper secured thereto, and means for adjusting the turnbeam to move the trash knife toward and away from one of the mill rolls. To provide the desired strength, the lower portion of the adjustable turnbeam is preferably mounted on a pivotal support, and to obtain the desired adjustments, a simple adjusting means adapted to co-operate with a turnbeam of this kind has been devised, the adjusting means having an operating member at the exterior of the mill housing where it will not be exposed to the chemical action of the juice passing from the cane. This strong and simple adjustable turnbeam is thus supported in such a manner that it can withstand the pressure of the cane to which it is subjected, and its adjusting means can be readily manipulated at the exterior of the mill housing.



In the drawing, *B* designates a large, heavy turnbeam extending across the mill housing at a point directly below the top roll *1*. *C* designates a trash knife secured to the upper edge of the turnbeam and provided with a scraping edge adapted to engage the roll *2*. This knife *C* prevents the trash from dropping with the juice which flows downwardly on the periphery of the roll *2*. The mass of cane passing over the top of the trash knife is subjected to the pressure of the top roll *1*, and this downward pressure is transmitted to the turnbeam *B*. The turnbeam is thus subjected to a very severe downward pressure, and it must be properly constructed and supported to withstand such pressure. For this reason the turnbeam is preferably a large, heavy casting, and its ends preferably rest upon pivotal members *4*, each of these being extended from a base *5* supported on the foundation of the mill. The lower end portions of the turnbeam *B* are curved to form seats which rest upon and conform to the curvature of the pivots *4*. *6* designates U-bolts securing the turnbeam to the pivots *4*. The substantial turnbeam is thus supported on a strong pivotal mounting, and it can be turned on the pivots to move the trash knife *C* toward and away from the roll *2*. The means for adjusting the turnbeam comprises lugs or pins *7* projecting from the upper end portions of the turnbeam, adjusting arms *8* having slotted lower ends in which the projections *7* are mounted, said arms *8* being located entirely within the mill housing and secured to oscillatory operating shafts *9* which extend through said housing. Operating arms *10* are located at the exterior of the housing and secured to the shafts *9*. It will be readily understood that the operating arms *10* at the exterior of the housing, are not exposed to the juice passing from the cane, and these arms can be easily adjusted for the purpose of oscillating the turnbeam *B* on its pivots *4*, thereby adjusting the scraping edge of the trash knife toward and away from the roll *2*. Since the adjusting arms *8* are slotted to receive the projections *7*, it is not necessary to accurately assemble the trash knife and adjusting means. After the operating arms have been adjusted, they can be secured to prevent the turnbean and trash knife from moving relative to the roll *2*. Threaded rods *11*, pivoted to the lower ends of arms *10*, are provided with nuts *12*, which may be adjusted toward lugs *13* for the purpose of securing the operating arms *10*. The threaded rods *11* pass through the lugs *13*, and the nuts *12* co operate with the lugs to prevent longitudinal movement of the rods *11*. The nuts *12* can also be adjusted for the purpose of transmitting movement to the operating arms *10*, thereby enabling the trash knife to be accurately adjusted by merely turning said nuts *12*.

MULTIPLE EFFECT EVAPORATOR. *Charles R. Mabee*, of Toledo, Ohio, U.S.A. *1,420,648*. June 27th, 1922. (Three figures; twenty claims.)

It has been ascertained that by subjecting a circular layer of material to rapid rotatable movement, relative to an externally heated cylindrical container, evaporation may be expeditiously carried on, and it is one of the primary objects of the present invention (stated to be suitable for the concentration of sugar juices) to adopt this general principle in obtaining multiple effect treatment. To this end an externally heated cylindrical container is employed with means for causing a relative rotatable movement between the container and a circular layer of material to be treated, and with means for introducing the vapours as they escape into the central zone within the layer of the material, into a heating space for a subsequent effect, and so on throughout the series of effects, means of communication being of course provided between the treating chambers for the material in the several effects. In prior apparatus of the multiple effect type, wherein vacuum was utilized, it was thought the addition of internal pressure to the liquid or material being treated would impede the evaporation. It has been found, however, from the operation of the present apparatus, that by the provision of means for treating the material under pressure, preferably centrifugal pressure, and maintaining the material under constant movement in layer formation while under pressure over the heated surface, better, more economical and more expeditious results are possible. The improved construction of multiple effect apparatus embodied herein is of a character wherein the operation may be successsully carried on either in connexion with employment of vacuum, or whereby the material is treated under pressure; but it is of advantage to operate under pressure in that condensers are dispensed with and the apparatus may be located at any convenient place, irrespective of large water supply. More particularly, the invention includes means whereby a layer of material is maintained in layer formation and under pressure while subjected to movement in a circular path over an externally heated cylindrical surface, with means whereby the vapour accumulating in the central zone maintained within the layer is conducted to the heating space of a subsequent effect to constitute the heat transmitting medium therefor.

What is claimed is: In a multiple effect evaporating apparatus, the combination of a plurality of end to end cylindrical containers, each of said containers having a surrounding jacket forming a heating chamber, said containers having an inlet for the material adjacent one end, and outlet for the treated material adjacent the opposite end, and said containers having an end opening of sufficient size to permit vapours to freely and rapidly escape, means for introducing a heating medium into the heating jacket of one container sufficient to evaporate liquid constituents of the material, and the vapour end opening of said container being in communication with the heating chamber of a succeeding container, and the discharge outlet of said container being in communication with the material inlet of a succeeding container, and co-operating movable means in the respective containers constructed and arranged to apply the material as introduced on to the inner surface of the containers under centrifugal force and pressure, and to subject said material while in continuous layer formation to rapid rotatable and simultaneous endwise movement towards the discharge end thereof.

Saccharine Trap (Anti-Entrainment Device or "Save-All"). *Godfrey Engel, Sr.* (assignor to *Buffalo Foundry & Machine Co.*, of Buffalo, New York). *1,415,818.* May 9th, 1922. (Two figures; three claims.)

Referring to the drawings, it is seen that the evaporator is of the usual construction, consisting of a shell or body *5* provided with an outlet neck *6*. This neck is formed with a vertically disposed discharge passage *7* in one side thereof, and baffles *8* are provided on the opposite vertical edges of this passage. These baffles may be provided by simply turning out the walls of the neck at the opposite edges of the opening. In addition, these baffle walls are provided with inwardly projecting angularly disposed ribs or flanges *9*, which exert a further baffling effect upon the outflowing vapour. Surrounding the neck portion of the evaporator is an annular wall *10* which, with the wall of the neck, forms an annular chamber *11* constituting the trap proper. The two annular walls described are connected at the bottom by inclined wall *12*, which forms one side of a collecting or drainage pocket in the bottom of the trap. The trap is closed at the top by a cover *13*, which for the purposes of repair and the like is made removable as indicated. At *14* is designated the condenser which is shown connected with the trap by means of a conduit *15*. This conduit enters the trap at a point substantially diametrically opposite the discharge opening *7* and at this outlet point additional baffle walls are provided, said baffle walls consisting of a flange *16* projecting inwardly into the annular chamber around the outlet opening. In the illustration is also shown the outer surrounding wall provided with inwardly projecting vertical ribs or flanges *17* extending into the annular chamber at opposite sides of the discharge opening *7* and down below the lower edge of said openings, so as to conduct the entrainment below the opening and so out of the direct path of the vapour. In this way, the entrainment is in effect positively carried away from the vapour current and the possibility of its being again caught up and carried off by the vapour is thereby eliminated. With the construction described, the vapours passing from the neck of the evaporator to the condenser are subjected to a baffling action, and the entrainment is caught by the ribs or baffling walls described, all of which drain into the annular pocket provided in the bottom of the trap. The accumulation of entrainment is drained off from the bottom of the trap in any suitable way; and it will be noted that the entrainment as it collects is out of the path of the current of vapour and so is not affected by the contant flow of vapour.

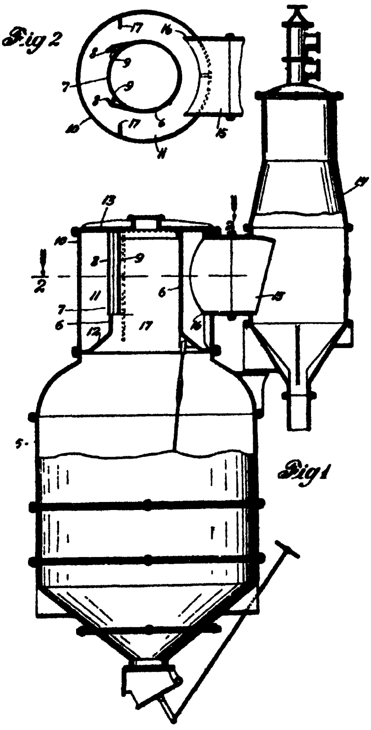


Fig 2

Fig 1

Cane Harvesting Apparatus. *Claude C. Hobson*, of Kenwood Park, Iowa, U.S.A. *1,425,479.* August 8th, 1922. (Nine figures ; ten claims.)

The inventor has conceived the idea of combining in one machine, mounted on a motor driven vehicle, means for cutting the stalks, and for gathering and conveying the same to rollers for expressing the juice. "As the machine is advanced over the field in a proper manner to allow the stalks of cane in a single row to come between the gathering boards, those stalks which are down or bent out of alignment, are picked up into upright position and carried in such position rearwardly, relatively speaking, to the rotary cutter at the apex of the throat, where the stalks are severed. The stalks from this point are conveyed laterally and discharged upon the elevating apron, which carries the stalks in horizontal position upwardly to the feeding conveyor. The stalks are now shifted in a longitudinal direction toward pressing rollers, and guided between said rollers by a shield. The juice, under the proper tension of the rollers, is pressed from the stalks and falls into an open shallow pan directly beneath said rollers, this pan preferably having a suitable screen so as to separate foreign matter which accidentally drops into the receptacle from the extracted juices. The juice then passes into a reservoir arranged at a lower elevation and capable of holding a suitable quantity by virtue of its size. Where the amount of extracted juices is likely to exceed the capacity of the reservoir in the particular operation, a suitable vehicle may be driven along beside the harvesting apparatus, or may be drawn by the harvesting apparatus itself, and the vehicle will embody a tank to receive the juices from the reservoir through a flexible conduit being pumped from the said reservoir by a proper pump device arranged at one end. The auxiliary vehicle referred to will then take the juices to the place for disposition in the evaporating pans for completion of the operation of extracting the sugar content. As the bagasse passes from the pressing rollers, it is directed by means of the deflector downwardly upon the ground. One of the advantageous features of this apparatus lies in the mounting of the special mechanisms for gathering, cutting, conveying and pressing the cane upon a platform, which is supported upon the cross frame pieces, so that these mechanisms may be bodily removed from the frame to permit the tractor vehicle to be utilized for other purposes than the special harvesting operation hereinbefore set forth."

Machine for picking and cutting Cane-Straw and ploughing under the Same. *Claudio G. Huelves*, of Santa Clara, Cuba. *1,374,149.* April 5th, 1921. (Twelve figures ; three claims.)

One object of the present invention is to effect improvements in the construction of the straw picking and cutting mechanism, in cane-straw picking, cutting and ploughing machines ; while another object is to effect improvements in the relative arrangement of the cutting mechanism and the ploughs, to facilitate the operation of the ploughs in hilling , follows :—In a straw-picking and cutting machine, a wheeled frame, a spur-gear, means to up or ridging the soil and in burying the cut straw thereunder. Claim 1 reads as cause said spur-gear to be rotated when the frame is in motion, a set of cutters mounted for rotation in relatively fixed bearings and having a gear engaging the first-named gear, a shiftable shaft, a second set of cutters mounted thereon, a gear on said shiftable shaft engaging the first-named gear, guide elements carried by the frame and having curved slots concentric with the first-named gear, bearings for the shiftable shaft and mounted for movement in said slots, a lever, and connexions between the lever and the bearings to enable the shiftable shaft to be moved by the lever to cause the second set of cutters to be moved toward and from the first-named set of cutters.

Cane Stripper. *Victor L. Covey*, of Tell City, Indiana, U.S.A. *1,424,989.* August 8th, 1922. (Four figures ; one claim.)

Presumably in regard to a small apparatus for use on the farm for the production on the small scale of sugar or syrup, claim is made for : The combination of a table-top having a transverse series of longitudinal slots therein, and a transverse slot in advance of the longitudinal slots, a transverse series of rigid pins rising from the table-top adjacent and in advance of the transverse slot and aligned with the respective longitudinal slots, co-operating upper and lower feeding rollers mounted respectively above and below the table-top in the vertical plane of the transverse slot, a rotatable stripper mounted below the table-top, blades carried by said stripper playing through the longitudinal slots in the table-top, a hood secured upon the table-top and housing the blades, the front and rear ends of said hood being open and the rear end contracted, and means for operating the stripper and the feed rollers.

Evaporator, having Rotatable Heating Elements. *Daniel H. Kleinschmidt*, of Buffalo, New York, U.S.A. *1,412,531.* April 11th, 1922. (Five figures; eleven claims.)

An object of the invention is to provide an evaporator having an internal rotatable member provided with heating elements, individually removable, so that repairs can be made and heating elements substituted without dissembling any of the parts, the tubes being removable through an opening provided in the casing of the apparatus. A further object is to so arrange the heating elements that they serve to create a circulation of the liquid material in the apparatus, all the heating elements constantly changing their positions during the rotation of the part carrying the same, thus preventing the material adhering to the tubes and encrusting thereon. These objects are realized by the combination of: a vertical casing having a pair of spaced openings arranged one above the other, a rotatable hollow member within said casing, means for introducing steam into said hollow member from the exterior of said casing, and a plurality of vertically-disposed tubes removably secured into said hollow member and in communication with the interior thereof, any or all of said tubes being removable through the lower of said openings to enable the substitution of tubes of similar length through said opening, or of greater length through the upper of said openings.

Filter-Press with Mechanically Operated Means of Opening Up and Closing Back. *Nelson A. Lockwood*, of Ogden, Utah, U.S.A. *1,390,531.* September 13th, 1921. (Six figures; seventeen claims.)

As hitherto practised, the opening up of filter-presses by moving or sliding each frame and plate on their support, and later of closing back these elements, has always been done manually, the sizes of the frames and plates being limited to the weight which a couple of men can handle; but the primary object of the present invention is to overcome this defect by installing mechanically operated means for shifting the frames and plates in such a way that the attention of one operative is required. As new and patentable, claim is made in a filter-press embodying a series of alternating juice plates, having channeled faces and hollow filter frames, with filter cloths stretched between said plates and frames all of which are operative along the press, the combination of a pair of longitudinally disposed side conveyors, each of which provides a series of driving parts actuating mechanism for said conveyors, a pair of side cylinders carried by each of said plate and frame units, with a pressure fluid conduit, formed in each unit that communicates with the cylinders thereof, and with a second pressure fluid conduit formed in each of said juice plate units, leading to the channeled faces thereof, each of said conduits being provided with an inlet opening, a retractile plunger element disposed in each of said cylinders and operable into detachable engagement with a complementary driving part of said carriers, and a suitably supplied detachable tube for delivering pressure fluid to the inlet openings of said conduits as desired.

Manufacture of Dextrin. *Jos. J. Merrill* (assignor to *Corn Products Refining Co.* of New Jersey, U.S.A.). *1,428,604.* September 12th, 1922. (Ten claims.)

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1922. Tons.		1921. Tons.
Total Receipts, January 1st to November 22nd	3,462.842	..	2,328,954
Deliveries ,, ,, ...	3,461,637	..	2,340,006
Meltings by Refiners ,, ,, ...	3,399,313	..	2,308,194
Exports of Refined ,, ,, ...	808,000	..	369,000
Importers' Stocks, November 22nd	1,205	..	—
Total Stocks, November 22nd	65,284	..	60,669
	1921.		1920.
Total Consumption for twelve months	4,107,328	..	4,084,672

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1919-1920, 1920-1921, AND 1921-1922.

(Tons of 2,240 lbs.)	1919-20. Tons.		1920-21. Tons		1921-22 Tons.
Exports	3,251,271	..	2,104,224	..	3,594,173
Stocks	293,674	..	1,152,222	..	223,397
	3,544,945		3,256,446		3,817,570
Local Consumption	79,700	..	105,000	..	125.000
Receipts at Ports to October 31st..	3,624,645		3,361,446		3,942,570

Havana, October 31st, 1922.

J. GUMA.—L. MEJER.

Beet Crops of Europe.

(Willett & Gray's Estimates to October 26th, 1922.)

	Harvesting Period.	1922-23. Tons.	1921-22. Tons.	1920-21. Tons.
Germany	Sept.-Jan...	1,600,000	1,305,810	1,152,960
Czecho-Slovakia	Sept.-Jan...	750,000	659,907	705,919
Hungary and Austria	Sept.-Jan...	69,500	78,822	47,977
France	Sept.-Jan...	560,000	278,273	305,041
Belgium	Sept.-Jan...	300,000	289,866	242,589
Holland................................	Sept.-Jan...	285,000	376,000	317,196
Russia (Ukraine, Poland, etc.).......... ..	Sept.-Jan...	220,000	49,374	88,490
Poland	Sept.-Jan...	270,000	225,000	189,834
Sweden	Sept.-Jan...	63,000	227,000	164,194
Denmark	Sept.-Jan...	105,000	146,800	134,835
Italy	Sept.-Jan...	260,000	217,500	135,484
Spain......................................	Sept.-Jan...	170,000	135,000	170,722
Switzerland	Sept.-Jan...	8,000	5,500	3,710
Bulgaria	Sept.-Jan...	25,000	22,000	7,837
Rumania	Sept.-Jan...	25,000	25,000	5,000
Total in Europe		4,710,500	4,041,852	3,671,788

Sugar Market Report.

Our last report was dated 9th November, 1922.

In the period that has elapsed, the sugar market has come more definitely under the influence of the strong statistical position that appears to be developing, the effect of which loses nothing by contrast with the almost overpowering surplus of supplies over requirements to which we were looking forward with much trepidation at this time last year. The more immediate effects of the position we are now confronting have been chiefly shown in the compulsion upon American refiners to secure the rapidly diminishing stocks of old crop Cubans at advancing prices and, on this side, by the introduction of a considerable speculative element in the shape of "outside" operators, whose attention has been drawn to the prospect of a profitable investment in sugar, partly by the publication of alarmist articles in the daily press. The effect of this is seen in the Terminal market quotations, the value of May delivery showing an advance of approximately 1s. per cwt. Present quotations are:—March 22s. 3d., May 22s. 6d.

When we come to actual white sugars, the effect, so far as it is reflected in the prices of near deliveries, is much less marked, due no doubt partly to the larger supplies of grocery descriptions which became available from the Continent as the refineries got to work on the new crops, and partly to the moderate level at which the British refiners have held their quotations, the latter being actually about 1s. per cwt. below those noted in our last report. London refiner's quotations for immediate delivery are:—No. 1 Cubes 56s., London Granulated 50s. 6d. duty-paid. During the past fortnight a brisk business has been done in Czecho-Slovak fine granulated, mainly in the form of re-sales of purchases made from refiners at an earlier date. SCH fine, and TTD A have been sold at 22s. 3d. to 22s. 4½d. f.o.b. Hamburg for December delivery, and other brands at similar prices; here and there 22s. 1½d. and even a shade less, has been accepted to dispose of ready lots for which the holders had no immediate use. Fine Dutch granulated has changed hands at round about 22s. 3d. and named marks of Belgian granulated at 21s. 6d. to 21s. 9d. f.o.b. Ordinary Belgian Crystals have been obtainable at prices up to 21s. 1½d. f.o.b. Forward deliveries of Continental sugars have been meagrely offered, refiners generally showing reluctance to quote for the Spring and Summer months. Some business has however been done in Czecho fine granulated for March/June at 23s. and April/Aug. at 23s. 6d. f.o.b. Hamburg. Czecho Cubes, ASP, etc., have been done at up to 26s. for ready and December delivery.

American Granulated is in moderate supply at 49s. 10½d. to 50s. Spot duty-paid, and there have been recently offers on this market of January-April shipment at 24s. 6d. to 24s. c.i.f., which are however above competing values for the time being. A good business, estimated in some quarters at nearly 50,000 tons altogether, has recently been done in new crop White Java Crystals for shipment to the U.K., May/June at 21s. 1½d. to 21s. 6d. and June/July at 21s. to 21s. 4½d. c.i.f. U.K. Ports. The present quotation for this sugar on the Spot is 47s. 9d. to 48s. 6d. according to quality, and Mauritius Crystals are quoted at about 9d. per cwt. less. There has been more demand for West India Crystallized at 43s. to 45s. 6d. according to quality.

Stocks in Cuba and America have reached a very low figure, and considering the present rate of melting by the U.S. refiners, would seem to be scarcely adequate to meet requirements, pending the receipt of new crop sugars in any quantity. Already the American refiners are apparently forced to compete for the small balance of old crop Cubans available and business has been done in 96 per cent. Centrifugals up to 4 cents per lb. c. & f. New York for December shipment. The new Cuban crop is reported to be progressing favourably and 11 Centrals are now at work. The last business reported in new crop is at 3½ cents for 96 per cent. sugar January shipment c. & f. New York. Offers made to the U.K. refiners in the neighbourhood of 17s. 3d. c.i.f. Feb./March shipment are said however to have elicited no response.

The Java market on the whole has maintained a very steady tendency with an active business passing, under which values advanced about half a guilder per picul. The tone recently has been quieter and present quotations are:—December/January 13⅛, January/February delivery 13 5/16 guilders first cost. So far as new crop is concerned, the Trust have made large sales and are reported to be outsold for May and June delivery. There has been some very limited business for India but so far any general revival in the demand from that quarter is lacking. White Javas c. & f. Calcutta are today quoted at 20s. 3d. for January and 20s. 4½d. for February/March shipments.

10 & 11, Mincing Lane,
London, E.C. 3,
7th December, 1922.

H. H. Hancock & Co.

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[(N.C.) implies *Note and Comment*; (Par.) *Paragraph;* (Corr.) *Correspondence;* (Abs.) *Abstract.*]

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